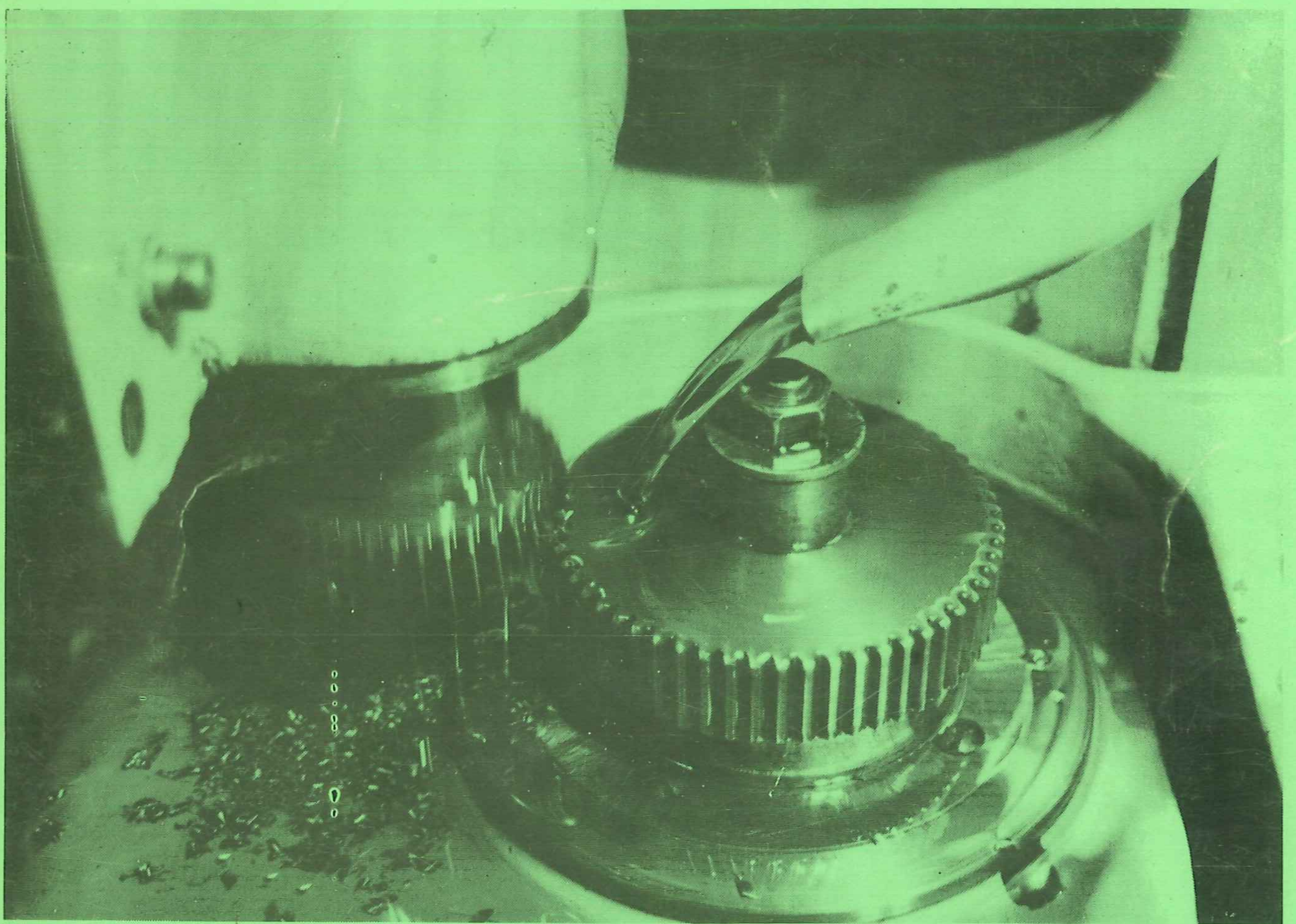
No. 16 June 1987 Nicosia Cyprus

Review

THE HIGHER TECHNICAL INSTITUTE



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Gear Shaping in progress at the HTI Gear Cutting and Training Centre.

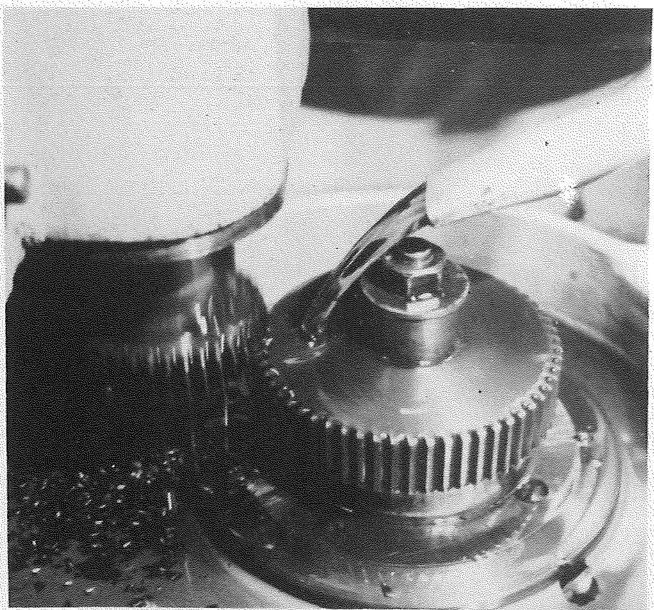

Photo by I. Angeli

H.T.I. Review is published by the Press and Information Office, in cooperation with the Higher Technical Institute, Nicosia. It accepts articles which promote and further new developments and knowledge in technology, especially with reference to Industries of Cyprus. Requests for further copies of the magazine and for information concerning the published articles should be made to Chief Editor H.T.I. Review, Higher Technical Institute, P.O.Box 2423 - Nicosia.

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CONTENTS

The Higher Technical Institute (H T I) was established in 1968 as a Government of Cyprus project with assistance by the United Nations Special Fund (UNDP), the United Nations - Educational Scientific and Cultural Organisation (UNESCO), and the International Labour Office (ILO). Cyprus Government Executing Agency: The Ministry of Labour and Social insurance.

Review

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EDITORIAL

The Engineer and New Technology

The Engineer has been described as the person who utilises the scientific discoveries and applies them to serve humanity in his effort to improve the quality of life and the standard of living. Unlike the past times when sciences were founded and developed while limited applications were achieved, today we are observers of a technological era with scientific applications in every aspect of life. In return scientists are now provided with high technology equipment creating new possibilities of research through data acquisition, manipulation and processing.

In this technological world the Engineer has found himself in the lead of innovation and development of new equipment giving rise to the widely discussed concept of new technology. The demands on the Engineer's shoulders are steadily increasing and usually the initial educational background is quickly overtaken by the rapid advancement of technology. The need, therefore, of sound basic training and carefully planned life-long updating on the latest developments becomes the crucial task for every technically oriented educational establishment.

Along these lines the basic training and the endorsement courses offered by the HTI have been adapted, through regular syllabus modifications, to the new trends in technology. Its academic staff being aware of its role to promote new technology and provide Cyprus with well trained and updated technical personnel has always shown interest in the latest technological developments while the imprortance of life-long education has been fully recognised. The articles of the present HTI Review contributed by HTI staff as well as other collaborating persons outline some of these interests.

The Editorial Committee

PROFESSIONAL UPDATING — A DIRE NEED

by Dr T Drakos MSc PhD CEng FIEE FIMechE

Abstract: Generally continuing education and training is a more complex and not less important subject than initial education and yet universally, it has not received the attention it deserves. Its complexity arises out of the fact that it involves the willingness and cooperation of employers to release staff for updating courses and foot most of the bill, the eagerness of persons already secured in emoloyment to pursue further training and the ability of course providers to indentify new needs and implement action accordingly. Its importance cannot be overemphasised if one considers the need to keep pace with rapid technological change. Without updating a vital factor in the economy i.e. technical manpower, is in danger of degradation and the primary purpose of updating is to maintain and enhance profitability, yet so far the little that is being done in this area is driven more by course providers rather than by industry and lacks the necessary structure.

1. Introduction

Although change is not something new, what characterises our modern world is the unprecedented rate of change. For example if we look at the technology of semiconductors we observe that currently the doubling time of its parameters is two years and dropping.[1] As a consequence of this unprecedented technological advance the working environment is undergoing an unbelievable upheaval since the advent of microelectronics. In some circles it is supported that the half life of an engineer is currently five years which means that fifteen years after initial education and training engineers without updating would be one eighth as proficient as at the beginning while long before the end of their career this proficiency will have been nearly completely eroded. In these circumstances the old cliche "we live and learn" and the still older Greek saying «γηράσκω αεί διδασκόμενος» are acquiring a new meaning. Professional updating in the face of rapid technological change is now viewed as an essential requirement rather than a hoped for need. Against this background Companies which would be committed to systematic continuing education for their personnel will be more successful than others which fail to do so.

2. Objectives

Updating and mid-career development of technical personnel can be summarised under three headings:[2]

a) To improve the performance of personnel on the job, thus contributing to higher economic benefits.

b) To maintain and improve the stock of skills and knowledge vested in the country's manpower.

c) To increase personal satisfaction and enhance the individual's development.

This order of priority reflects the importance of updating in terms of its contribution to economic performance while not excluding the human aspect which provides much of the necessary incentive. Accepting that competence leads to competitiveness we recognise a clear link between investment in further education and training and competitive success.

Updating objectives may be defined as short-term or medium term and may be directed towards solving specific problems. Such training is therefore differentiated from the usually broad initial education and training which has long-term objectives. Training for updating usually takes the form of a short accelerated course covering a specialised topic. Such training may be informal or formal, it may be carried out at the workplace or eslewhere and may include systematic on-the-job training and attendance at short courses or seminars. Distance learning is also now being developed.

With the effects of the new technology permeating the whole economy it is difficult to exclude any topic from the need for updating. Several topics of high technology, new products and techniques, control of resources, management methods, legislation and personnel updating is unquestionably necessary. In every case updating should be concerned with current and projected applications and not be merely a theoretical exposition.

3. Structure

Unfortunately this important aspect of training does not anywhere follow a structured pattern which would guarantee a sound continuing formation for professionals.

Fortunately it is already becoming the subject of much debate in many advanced countries where its significance is now fully recognised. Germany and Japan are already implementing systematic updating in some areas and in France and some other European Countries a levy scheme combined with a statutory right to study leave is in operation and this creates favourable conditions for continuing education. The situation universally is, however, far from satisfactory and what has already been achieved barely scratches the surface of an enormous problem.

In the United Kindom much debate is in progress with a view to structuring updating programmes and develop systems of certification, validation and continued monitoring. The UK Engineering Council has defined a Continuing Education and Training Unit (CETU) as' ten contact hours of participation in organised continuing education under responsible sponsorship, capable direction and qualified instruction'.[3] Proposals have been made for an agreed annual measure of Continuing education (for example 2 CETU'S or 20 hours per annum) as a pre-condition for remaining on the professional register. Various pros and cons are being voiced regarding such a compulsory updating scheme, the main objection bei the difficulty in assessing true competence which arguably can also be enhanced by self study a d tutoring by colleaques at work. The situation in some professions in the United Kingdom is given in table 1.

Table 1 — Outline of Updating requirements in some UK professions

Name of body	Date started	Resume of requirement	Cost
Institute of Chartered Accountants	1978	33 hours structured/year 50 hours unstructured/year total 83 hours/year	Not given
Institute of Actuaries	Not yet	Under comideration	
Royal Institute of British Architects		Mandatory scheme rejected. Signified professional obligation being considered	
Law Society (Solicitors)	1985	Mandatory attendance at recognised course for 3 years (Equivalant: 3 days/year)	£150-£540 (Course cost only)
Royal College of Surgeons		Against mandatory scheme. Eucourage voluntary learning	
Royal Institute of Chartered Surveyors	1981	Average of 20 hours/ year in various activities	Not given
Engineering Instututions		Under Consideration	

Source: The Engineering Council: A call to Action, 1986

In Cyprus no mandatory scheme is either operating or under consideration but the sheer need to keep abreast with technological developments has prompted industry to implement a fairly extensive programme of updating. Two important functions namely "responsible sponsorship" and "capable direction" have been actively practiced by the Industrial Training Authority of Cyprus and "qualified instruction" has been secured, in sime cases by importing specialised services from abroad. Cyprus can perhaps boast for one of the most commendable records anywhere in updating work when in 1986 it has involved about 10,000 working persons in continuing education for an average of about 20 hours of coursework per person.

4. Resources

Funding of countinuing education must be considered from the viewpoint of its objectives and the parties it is designed to benefit. As mentioned earlier the parties which directly or indirectly stand to gain from the continuing education of manpower are employers, the state in general and the individual employee. It is therefore only fair that all these beneficiaries contribute to the effort of updating. Industry is naturally expected to cover most of the cost which to an employer would form part of operating costs. Where a levy scheme operates as for example in Cyprus this becomes a means of putting into updating the effort and resource it rightly deserves. Government offers encouragement through available facilities and the employees contribute by accepting a measure of inconvenience and train often in their own free time.

Academic Institutions ehich could be course providers must attribute to updatind a central role and establish systems for marketing and operating continuing education on a professional basis. It may be worth mentioning that for such work arrangements must be made for the teaching staff itself to be update although the occasional use of outside services may be the most economical solution in some cases.

5. Conclusions

Internationally there seems to be much too little effort put into continuing education and training and this should not be an acceptable position at the present time. For strong economic reasons and to capitalise on new technology and new techniques much more attention to updating must be given by Industry, Government, professionals and course providing Institutions.

Above all a structure must be provided which would relate training objectives to the content and standard of training and to resources, spelling out in unmistakable terms the benefits to be derived. In Cyprus the Industrial Training Authority is planning a specific updating system within an overall plan for systematic updating. Naturally for the successful implementation of these plans the cooperation of all parties concerned is necessary. Clearly urgent action is needed by Industry and Training Organisers to realise the full potential of a systematic approach to structured updating.

References

1. Prof B Cohen, The Education of the Information Systems Engineer.

Electronics & Power, IEE, March 1987.

2. T.J. Cannell
   The Updating of Engineers
   Proc. IMechE Vol. 199, 1985

3. Engineering Council
   A Call to Action, 1986

PSYCHOLOGICAL TYPES AND THE STUDY OF ENGINEERING

by Prof. Floyd G. Delon, Ed. D.*

Introduction:

Engineering educators in the United States have given considerable attention in recent years to the improvement of instruction. One of the recognized leaders in this regard is Lee Harrisberger who described his work in this way: "I have scratched about to find a little of what nature will allow, what parameters have to be dealt with, and what experimenters have found...."[1] The key to working with people, he concluded, is a better understanding of human behaviour. Harrisberger was convinced that in an educational settling, the "experimenters had found" the solution in the theory of the Swiss psychologist, C. G. Jung, on psychological types.

Psychological type theory lends itself well to empirical research and to practical application because it is concerned with the conscious aspects of personality. The theory is particularly relevant to education in that it deals with how people acquire information and how they decide what to do about the information they acquire. Specifically, the theory states that there are two opposite ways of becoming aware--*sensing* and *intuition.* Likewise, there are two opposite ways of reaching conclusions -- *thinking* and *feeling.* Depending on whether the individuals preference is for "becoming aware" or "reaching conclusions", the categories --*perception* and *judgment* emerge. Finally, Jung indentified two opposite attitudes either focusing outward toward or inward from the individuals environment-- *extraversion* and *introvesion.*[2] The possible combinations of these traits yield what Jung described as the sixteen psychological types.

Psychological type theory provides a basis for analyzing many of the problems of teaching and learning. For example, instructors have probably wondered why they are sometimes more effective with one class than with another in the same subject? why some students grasp concepts quickly while other equally bright students have difficulty? Students may I have also wondered why they enjoy the classes of some instructors and not others? why learning seems easier in some classes than in others although the subject matter may be the same level of difficulty? why they may relate well personally to some instructors and not to others? Generally speaking, these questions appear to be answered to a great extent by the research on psychological types.

Identifying Psychological Type

Of the instruments devised to identify psychological types, the most widely used is the Myers-Briggs Type Indicator (MBTI). This instrument contains 130 items that require about thirty minutes to complete. Instructors may purchase copies and answer sheets from: Consulting Psychologist Press; 577 College Avenue; Palo Alto, California 94306 U.S.A. The higher score on each of the paired descriptors identifies the psychological type.

A shortened form of the instruments, is included in the appendix to this article. This instrument provides some indication of psychological type although the scores lack the validity and reliability of the complete instrument from which it was derived. *The reader should complete the instrument at this time,* indentifying his or her psychological type. It should be stressed that for best results, the choices should be made as quickly as possible for first impressions are more likely to reïpresent true preferences. According to Jung's theory people exhibit each of eight factors but it is the preference between the opposite factors that is significant. The scores on each dimension will indicate whether the individual is:

an Introvert (I) or an Extravert (E)
a Sensing (S) type or an Intuitive (I) type
a Thinking (T) type or a Feeling (F) type
a Perceptive (P) type or a Judging (J) type

Combined, the four indicators signify one of the sixteen psychological types:

ISTJ	ISFJ	INFJ	INTJ
ISTP	ISFP	INFP	INTP
ESTP	ESFP	ENFP	ENTP
ESTJ	ESFP	ENFJ	ENTJ

The reader, knowing his or her psychological type, can relate personally to the descriptions of teaching and/or learning styles.

Psychological Type Characteristics (Including Teaching/Learning Style)

The researchers have been able to associate particular characteristics, including teaching and learning styles, with the psychological types and their component elements. Some of the more important findings are presented here in tabular form. The first table contains the contrasting characteristic of "Introverts" and "Extraverts".

"E"

- ☐ Like variety, action
- ☐ Tend to be faster dislike complicated porce-dures
- ☐ Often good at greeting people
- ☐ Interested in the results, getting the job done
- ☐ Do not mind interruptions
- ☐ Act quickly, sometimes without thinking
- ☐ Like to have people around
- ☐ Usually communicate freely

"I"

- ☐ Like quiet for concentration
- ☐ Careful with detail, dislike sweeping statements
- ☐ Have trouble remembering names and faces
- ☐ Do not mind long jobs
- ☐ Interested in the idea or rationale of the job
- ☐ Dislike interruptions
- ☐ Like to think before they act
- ☐ Like to work alone
- ☐ Have some problem communicating

There are also marked differences in the learning preferences of "extraverts" and "introverts". The next table lists the major contrasts.

"E"

- ☐ Talking, discussion
- ☐ Psychomotor activity
- ☐ Working with a group

"I"

- ☐ Reading, verbal reasoning
- ☐ Reflective thinking
- ☐ Working individually

The differences in the way people prefer to become aware of information also produces a contrasting list of characteristics. These specific preferences of the "sensing" and of the "Intuitive" types are presented in the third table.

"S"

- ☐ Dislike new problesm
- ☐ Like an established way
- ☐ Enjoy using acquired skills
- ☐ Usually reach a conclusion step-by-step
- ☐ Patient with routine
- ☐ Impatient with complicated situations
- ☐ Seldom make errors of fact
- ☐ Good at precise work

"N"

- ☐ Like solving new problems
- ☐ Dislike repetition
- ☐ Enjoy learning new skills
- ☐ Reach a conclusion quickly
- ☐ Impatient with routine
- ☐ Patient with Ciplicated situations
- ☐ Make errors of fact
- ☐ Dislike taking the time for precision

The learning styles or preferences of "sensing" types and "intuitive" types also differ. The five major differences are listed in the next table.

"S"

- ☐ Carefulness, thoroghness, understanding
- ☐ Step-by-step approach
- ☐ Observing specifics
- ☐ Memory of facts
- ☐ Practical interests

"N"

- ☐ Quickness of insight, seeing relationships
- ☐ Finding own way
- ☐ Grasping general concepts
- ☐ Verbal fluency
- ☐ Intellectual interests

As the listing in the fifth table indicate, the distinctions between the characteristics of the "thinking" type and the "feeling" type are also significant.

"T"

- ☐ Do not show emotion readily. Often uncomforta-ble with other peoples' feelings
- ☐ May unknowngly hurt other peoples's feelings
- ☐ Like to analyze and put things in logical order
- ☐ Reach decisions impersonally

"F"

- ☐ Aware of other peoples-feelings
- ☐ Enjoy pleasing people
- ☐ Decisions are influenced by their own and others likes and dislikes
- ☐ Need occasional praise
- ☐ Sympathetic

The learning preferences of the "thinking" types and the "feeling" types may by summerized with two statements each:

"T"

- ☐ Logical organization of the teacher
- ☐ Books and other materials to study

"F"

- ☐ Personal rapport with the teacher
- ☐ Learning through personal interaction with other

The stated earlier, the fourth dimension is concerned with whether the individual 'preference is for "becoming aware" or for "making decisions". The characteristics of these categories referred to as the "perceiving" and "judging" types, respectively, appear in the seventh table.

"P"

- ☐ Adapt well to changing conditions
- ☐ Do not mind leaving things open
- ☐ May have trouble making decisions
- ☐ May become overcommitted
- ☐ May postpone unpleasant tasks
- ☐ Tend to curious, welcome new challenges

"J"

- ☐ Work best when they can follow the plan
- ☐ Like to attain closure
- ☐ May decide too quickly
- ☐ Disike stopping one task to work on a more urgent one
- ☐ May not notice new things that need to be done
- ☐ Tend to become satisfied when a decision is made

The learning preferences of the "perceiving" type and The "judging" types tend to follow patterns similar to each listings just presented.

"P"

- ☐ work in a flixible way, follow impulses
- ☐ Informally problem-solving
- ☐ Discovery tasks

"J"

- ☐ Work in a steady, orderly way
- ☐ Formalized instruction
- ☐ Structured tasks

In the ninth table, some of the characteristics of teachers (Instructors) having a given combination of two preference traits is presented.

SP

Projects, contests, shows, demonstrations

SJ

Drill, papers, tests demonstrations

NT

Lectures, Tests, projects, reports

NF

Group projects, Discussion, games simulations

The tenth and final table contains a concise description of the characteristics most frequently associated with each of the sixteen psychological types [3].

ISTJ

Serious, quiet, earn success by concentration and thoroughness. Practical, orderly, matter-of-fact, logical, realistic and dependable. See to it that everything is well organized. Take responsibility. Make up their own minds as to what should be accomplished and work toward it steadily, regardless of protests or distractions.

ISFJ

Quiet, friendly, responsible and conscientious. Work devotedly to meet their obligations and serve their friends and school. Thorough, painstaking, accurate. May need time to master technical subjects, as their interests are usually not technical. Patient with detail and routine. Loyal, considerate, converned with how other people feel.

ISTP

Cool onlookers-quiet, reserved, observing and analyzing life with detached curiosity and unexpected flashes of original humor. Usually interested in impersonal principles, cause and effect, how and why mechanical things work. Exert themselves no more than they think necessary, because any waste of energy would be inefficient.

ISFP

Retiring, quietly friendly, sensitive, kind, modest about their abilities. Shun disagreements, do not force their opinions or values on others. Usually do not care to lead but are often loyal followers. Often relaxed about getting things done, because they enjoy the present moment and do not want to spoil it by undue haste or exertion.

INFJ

Succeed by perseverance, originality and desire to do whatever is needed or wanted.a Put their best efforts into their friends and school. Put their best efforts into their work. Quietly forceful, conscientious, concerned for others. Respected for their firm principles. Likely to be honored and followed for their clear convictions as to how best to seve the common good.

INTJ

Usually have original minds and great drive for their own ideas and purposes. In fields that appeal to the,,, they have a fine power to organize a job and carry it through with or without help. Skeptical, critical, independent, determined, often stubborn. Musy learn to yield less important points in order to win the most important.

INFP

Full of enthusiasm and loyalties, but seldom talk of these until they know you well. Care about learning, ideas, language and independent projects of their own. Tend to undertake too much, then somohow get it done. Friendly, but often too absorbed in what they are doing to be sociable. Little concerned with possessions or physical surroundings.

INTP

Quiet reserved, brilliant in exams, especially in theoretical or scientific subject. Logical to the point of hair-splitting. Usually interested mainly in ideas, with little liking for parties or small talk. Tend to have sharply defined interests. Need to choose careers where some strong interest can be used and useful.

ESTP

Matter-of-fact, do not worry or hurry, enjoy whatever comes a long. Tend to like mechanical things and sports, with friends on the side. May be a bit blunt or insensitive. Can do math or science when they see the need. Dislike long explanations. Are best with real things that can be worked, handled, taken apart or put together.

ESFP

Outgoing, easygoing, accepting, friendly, enjoy everything and make things more fun for other by their enjoyment. Like sports and making things. Know what's going on and join in eagerly. Find remembering facts easier than mastering theories. Are best in situations the need sound common sense and practical ability with people as well as with things.

ESTJ

Practical, realistic, matter-of-fact, with a natural head for business or mechanics. not interested in subjects they see no use for, but can apply themselves when necessary. Like to organize and run activities. May make good administrators, especially if they remember to consider other's feelings and points of view.

ESFJ

Warm-hearted, talkative, popular, conscientious, born cooperators, active committee members. Need harmony and may be good at creating it. Always doing something nice for someone. Work best with encouragement and praise. Little interest in abstract thinking or technical subjects. Main interest is in things that directly and visibly affect people's lives.

ENFP

Warmly enthusiastics, highspirited, ingenious, imaginative. Able to do almost anything that interests them. Quick with a soloution for any difficulty and ready to help anyone with a problem. Often rely on their ability to improvise instead of preparing in advance. Can usually find compelling reasons for whatever they want.

ENTP

Quick, ingenious, good at many things. Stimulating company, alert and outspoken. May argue for fun on either side of a question. Resourceful in solving new and challenging problems, but may neglect routine assignments. Apt to turn to one new interest after another. Skillful in finding logical reasons for what they want.

ENTJ

Heartly, frank, able in studies, leaders in actiovities. Usually good in anything that requires reasoning and intelligent talk, such as public speaking. Are usually well-informed and enjoy addidng to their fund or knowledge, May sometimes be more positive and confident than their experience in an area warrants.

ENFJ

Responsive and responsible. Generally feel real concern for what others think or want, and try to handle things with due regard for other people's feelings. Can present a proposal or lead a group discussion with ease and tact. Sociable, popular, active in school affairs, but put time enough on their studies to do good work.

Conclusion

What types are represented among engineering students in the United States? McCaulley's findings indicate that they prefer "introversion" over "extraversion" almost three to one. There were no significant differences among the specialty areas in engineering in this respect. However, the applied fields attracted more of the "sensing" types while the fields concern more with theory attracted more of the "intuitive" types. For example, civil engineering had more "sensing" types and nuclear engineering had more "intuitive" types. The "thinking" types were in the clear majority in all engineering specialties. Finally, as contrasted to other fields of study, engineering had the highest percentage of "judging" types. The typical engineering student, then, would be classified as an ISTJ.

In closing, it can be observed that an increasing number of engineering schools are using the psychological types approach. An instructor, knowing his psychological type and that of his students, can use a teaching style that best fits the learning styles of his students and thereby improve instruction.

References and Notes

★ Professor of Educational Administration, University of Missouri; Columbia, Mo. U.S.A. (on leave)

1. Harrisberger, L. *On Creating a Motivational Environment for Learning.* (Unpublished Workshop Agenda) 1985. Dr. Harrisberger is a professor of engineering at the University of Alabama.

2. McCaulley, M.H. "Psychological Types in Engineering: Implications for Teaching", *Engineering Education,* 66:7, April 1976.

3. Harrisberger, *op cit.*

4. For example, University of Alabama, University of Missouri, Cleveland State University, University of Florida.

Questionnaire: Indentifying Your Style

PART I. Circle the answer which come closest to how you usually feel or act.

1. Are you more careful about:
   A. people's feeling
   B. their rights

2. When you have to meet strangers, do you find it:
   A. something that takes a good deal of effort
   B. pleasant, or at least easy

3. Does following a schedule:
   A. appeal to you
   B. cramp you

4. Do you usually get on better with:
   A. imaginative people
   B. realistic people

5. Are you naturally:
   A. rather quiet and reserved in company
   B. a good "mixer"

6. Is it harder for you to adapt to:
   A., routine
   B. constant change

7. Which of these two is the higher compliment:
   A. he is a person of real feeling
   B. he is consistently reasonable

8. Would you judge yourself to be:
   A. more enthusiastic than the average person
   B. less excitable than the average person

9. In doing something with many other people, does it appeal more to you:
   A. to do it in the accepted way
   B. to invent a way of your own

10. Are you at your best:
    A. when following a carefully worked out plan
    B. when dealing with the unexpected

11. Do you get more annoyed at:
    A. fancy theories
    B. people who don't like

12. Is it higher praise to call someone
    A. a man of vision
    B. a man of common sense

13. Do you more often let:
    A. your heart rule your head
    B. your head rule your heart

14. When you think of some little thing you should do or buy, do you:
A. often forget it until much later
B. usually get it down on paper before it escapes you
C. always carry through on it without reminders

15. Can you:
A. talk easily to almost anyone as long as you have to
B. find a lot to say only to certain people or under certain conditions

16. Do you think it is a worse fault:
A. to show too much warmth
B. to be unsympathetic

17. If you were a teacher, would you rather teach:
A. courses involving theory
B. fact courses

18. When it is settled well in advance that you will do a certain thing at a certain time, do you find it:
A. nice to be able to plan accordingly
B. a little unpleasant to be tied down

19. Can the new people you meet tell what you are interested in:
A. right away
B. only after they really get to know you

20. In your daily work, do you (for this item only, if two are true, mark both):
A. rather enjoy an emergency that makes you work against time
B. hate to work under pressure
C. usually plan you work so you won't need to work under prossure

21. In a large group, do you more often:
A. introduce others
B. get introduced

Part II. Circle the letter of the word or phrase that expresses your preference in each item

22. A. Acting on your feelings
B. Following a plan

23. A Following a tight schedule
B. Taking your time

24. A. Justice
B. Mercy

25. A. Production
B. Design

26. A. Beginning
B. End

27. A. Soft
B. Firm

28. A. Lenient
B. Critical

29. A. Calm
B. Active

30. A. Theory
B. Experience

31. A. Literal
B. Symbolic

32. A. Creative
B. Established

Scoring: Record 1 point in the designed space for each response circled and total each column.

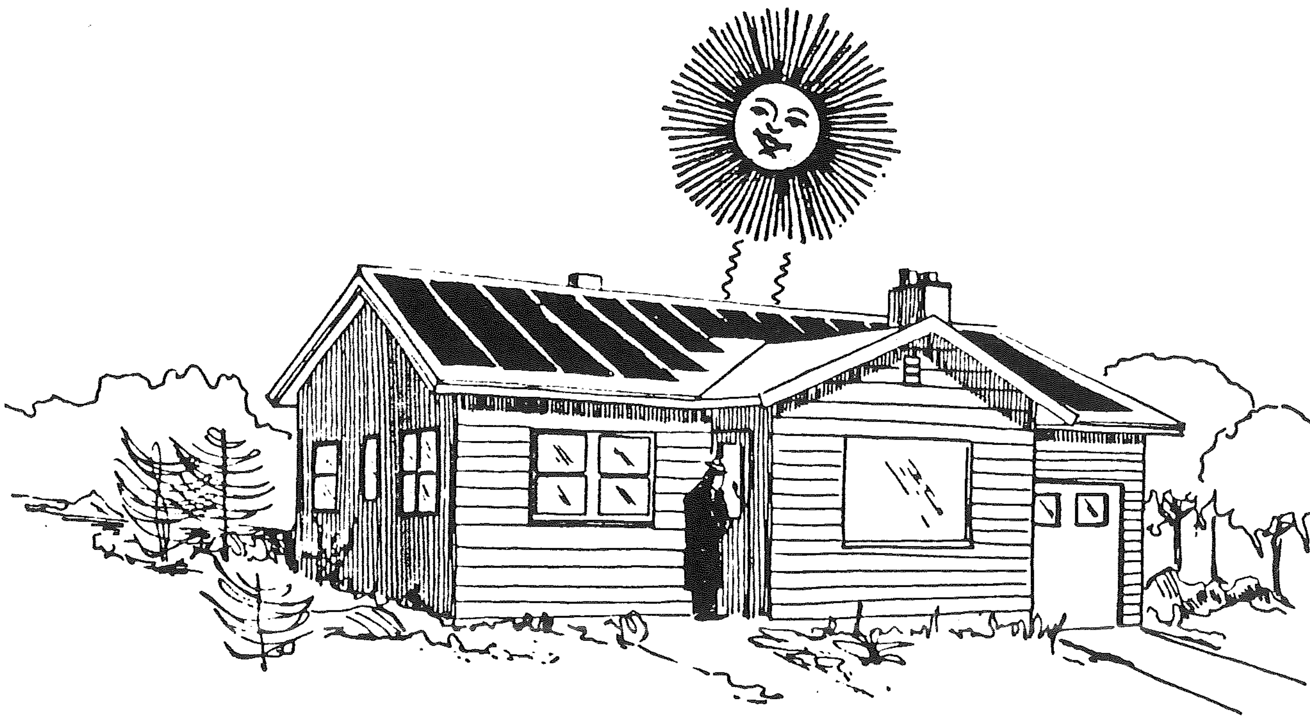
E	I	S	N	T	F	P	J
2B	2A	4B	4A	1B	1A	3B	3A ....
5B	5A	9A	9B	7B	7A	6A	6B ....
8A	8B	11A	11B	13B	13A	10B	10A ....
15A	15B	12B	12A	16A	16B	14A	14B ....
19A	19B	17B	17A	22B	22A	18B	18A ....
21A	21B	25A	26B	24A	24B	20A........	20C ....
29B	29A	30B	30A	27A	27A		20B ....
		31A	31B	28B	28A	23B	23A ....
Totals ____	____	____	____	____	____	____	____

Type (LETTER OF HIGHER TOTAL FOR EACH OF THE FOUR PAIRS

____ ____ ____ ____

SOLAR HEATING IN CYPRUS

by I. M. Michaelides, CEng Minst E
Senior Lecturer (Mech. Eng.), HTI



ABSTRACT

This paper aims to review the present situation and potential of the utilisation of Solar Energy for water heating, space heating and greenhouse heating in Cyprus. It is pointed out that the geographical location together with the climatic and weather conditions of Cyprus are such that classify it as one of the countries where the potential of solar energy is very high. Cyprus has the first place among European and Mediterranean countries in solar water heating: one solar heater for 5 people in the country.

1. INTRODUCTION

Cyprus enjoys a very sunny climate with an average annual solar radiation of 5.3 $KWh/m^2/day$ (on a horizontal surface). For the whole year, the average number of hours of bright sunshine is 75% of the time during which the sun is above the horizon. This factor is extremely favourable for solar energy utilization. Even in winter the sunshine duration is sufficient for solar utilisation: average of 5.5 hours of bright sunshine in December and January, the cloudiest months; 60% of day-time weather is clear in winter (90% in summer).

The almost full reliance of Cyprus on imported oil for meeting its energy demand, together with the adundance of solar rediation and a good technological base created favourable conditions for the exploitation and development of renewable energies, which represent the only domestic resources of energy.

The first application that has been historically developed in Cyprus, regarding renewables, is the use of windmills for irrigation purposes. In the early 1930's, hundreds of windmills were set up in the South-east coastal areas to irrigate small plots of vegetables (tomato, cucumber and potatoes). This application grew quickly but became declining in the 1960's while gas-oil diesel pumps overspread due to very low oil price.

The 1973 oil crisis has waken up again the interest for this technology, but the economic analysis is still not in favour of windmills.

A second mass-extended utilization of a renewable source of energy appeared in the early sixties; as solar water heaters were developed on a large scale in Isreal, Cypriot manufacturers once copied some isreali products and quickly created a national industry which is today the most important in the world regarding the number of annual square meters of collectors manufactured divided by the population. Cyprus produces today more than 30,000 sqm of collectors per year and 9% of the total electricity consumption is replaced by solar energy utilization.

2. SOLAR WATER HEATING

2.1. Relevant Socio-economic data

The forms of energy used for water heating are electricity, gas, oil, solar, wood and charcoal.

According to a survey conducted in 1979, by the Statistics and Research Department of the Republic, for hot water production, 47.4% of households used electricity, 33.5% solar, 16.2% wood, 13.4% gas and 1.8% oil. In 84.5% of the homes using solar energy for water heating electricity was used as auxiliary source.

No hot water supply was recorded for 21/% for households, 43% of homes on the mountain areas had no hot water supply as compared to 28% in plain areas and 10.3% in towns.

The situation today is of course different, especially with regards to solar.

2.2. Development of Solar Water Heating

Cyprus begun to manufacture Solar Water Heaters (SWH) in the early sixties. Cypriot industry of solar water heaters quickly expanded to reach 30,000 $m^2$of collectors produced in 1983, by more than 20 manufacturers. Today, Cyprus produces more than 30,000 m^2 of flat-plate solar collectors per year and 9% of the total electricity consumption is replaced by solar energy utilisation.

A typical solar water heater in Cyprus consists of two flat-palte solar collectors having an absorber area of $3m^2$, a storage tank of 180 litres equipped with an auxiliary electric heater of 3KW, and a cold water tank on top. The layout of such a unit is illustrated in figure 1.

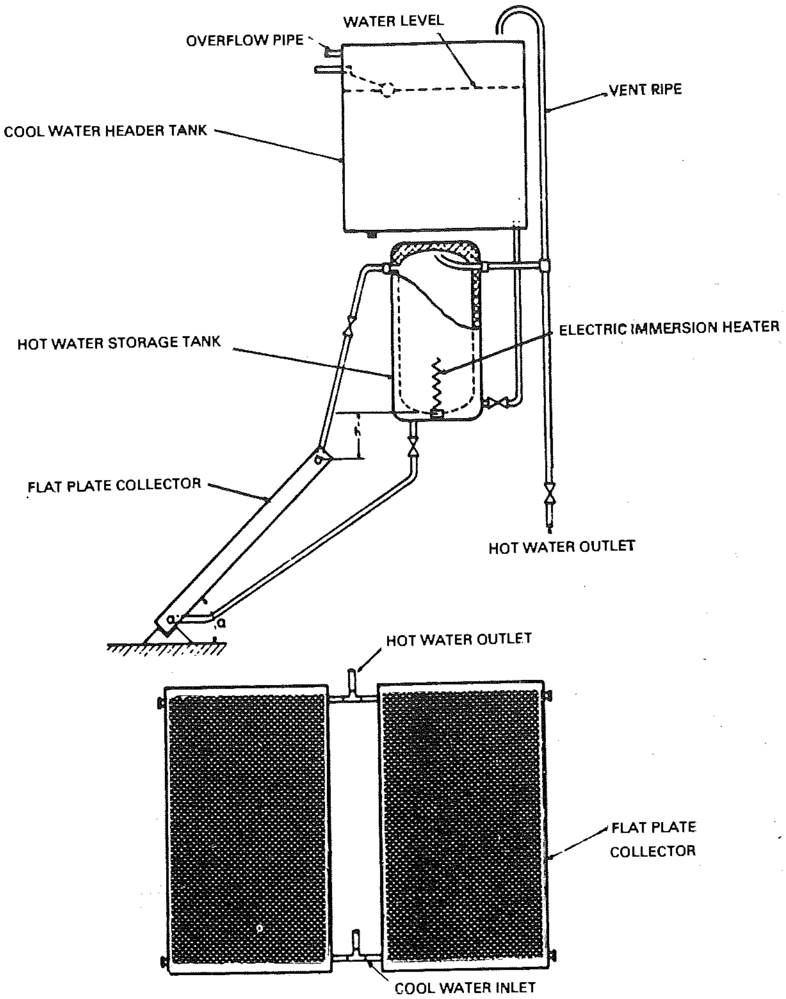


Fig. 1 Typical Solar Water Heater in Cyprus

2.3. Contribution of Solar Water Heatinga to the energy balance

With about 109,000 solar water heaters in January 1984, Cyprus has the first place among European and Mediterranean countries: One Solar Water Heater for 5 people in Cyprus!

The estimated collector area installed in Cyprus (1.1.1984) is about 339,000 m^2 out of which 294,000 m^2 in houses, 33,000m^2 in flats and the rest in hotels and hospitals or clinics.

A survery conducted by the consultants to the Government in the Energy Planning and Conservation Project has concluded that as on Jaunuary 1983 the percentage of buildings equipped with solar water heating, per category of building, were as follows:

Individual houses	90%
Flats	15%
Hotels and Hotel appartments	50%

For the new buildings completed during 1983, the percentages were estimated by the consultants, as:

Individual houses	90%
Flats	25%
Hotels and Hotel appartments	90%

In the absence of monitoring program for energy performances of installed SWH's the energy contribution is estimated to 1,050 kWh/year per SWH, under the following conservatinve assumptions:

- Collector area of one SWH unit .... 3 m^2
- average daily solar radiation, (collector tilt angle 35^0) .... 5.4.kWh/m^2
- Solar water heater average efficiency (1) 0.3
- usefulness of solar hot water (2) 0.6

Under these conditions, the useful yearly energy produced, E_u is:

E_u= 3X5.4X0.3X0.6X360=1050 KWh

Thus, the annual energy saved is 1050kWh/yr per SWH (for comparison: 1440 kWh/yr/SWH in the South of France).

The annual energy savings provided by SWH's installed in Cyprus (1983) are estimated using the followinq assumptions:

- number of existing SWH's (1.1.1983) .... 101,000 units
- average annual energy saved per SWH .... 1,050 KWh/yr
- rate of uitilisation of the present stock of SWH in Cyprus (3) 0.9

Estimated electricity savings (4)
= 101,000x0.9x1,050=95GWh

Estimated H.F.O. savings (5)
= 95X10^6 kWhx0.34=32,320 Toe

Thus, the estimated energy saved by existing solar water heaters in 1983 are 32,300 Toe.

With regards to the contribution of SWH to the national energy balance, 95 GWh of electricity saved by SWH represents about 9% of 1983 national electricity consumption, or about 3% of the national energy consumption for 1983. These percentages are, very likely, the highest of the World.

2.4. Cost-effectiveness of Solar Water Heaters

Different case studies have been carried out to investigate the cost-effectiveness of solar water heating in the various sectors: individual houses, flats, hotel apartments, hotels and industry. The cost-effectiveness of solar water heaters depend primarily on the "competing" source of energy and varies from 4 to more than 10 years.

Following is a case study concerning individual solar water heater intended for a typical Cypriot family of 4 persons, installed in a residential house.

For this purpose the following facts and assumptions are used:

a) Hot water demand

- daily hot water requirements .... 170 lt
- hot water temperature .... 45^0 C
- cold water temperature .... 18 ~ 25 ^{0}C

b) Solar Water Heater(SWH) technical data

- collector area .... 3 m^2
- storage tank .... 180 lt
- auxiliary electric element .... 3 kW
- overall efficiency of SWH:
  : in summer 30%
  : in winter 25%
- collector tilt angle .... 35^0
- average solar radiation in summer .... 6.3 kWh/m^2
- average solar radiation in winter .... 4.3 kWh/m^2

c) Cost of SWH

- solar collector .... C£130
- storage tak with electric element ... C£70
- cold water tank .... C£ 75
- supporting structure .... C£ 50
- piping, fittings, etc .... C£ 10

The average daily energy requirements for the period of October to April are:

$170 x 1.16 x 10^{-3} x (45-18)$ kWh/day

or approximately 5.33kWh/day

For the same period, the average solar energy collected is approximately: 3x4.3 x 0.25= 3.23 kWh per day.

Thus, a difference of 5.33 - 3.23 = 2.10 kWh per day has to be supplied by electricity.

For the period of May to August, the daily average energy demand is:

$170 x 1.16 x 10^{-3} x (45 - 25)$ kWh/day

or approximately 3.95 kWh/day

During this period there is a surplus of solar energy, thus there is no electricity consumption. Therefore, the average yearly energy demand is:

200 x 3.95 + 165 x 5.33 kWh

or approximately 1670 kWh/year

Savings in electricity: 200x3.23+165x3.95 kWh

or approximately 1300 kWh/year

Yearly back-up electricity consumption: 370kwh/year

Annual electricity expenses savings: 1300 x 4 cents

or approximately C£52

Taking the capital cost for the solar components as C£260 and assuming that the cost of an electric water heater to satisfy the above needs is about c£60, then the extra capital cost for the SWH is about C£200.

Thus, pay-back period is 200 ÷ 52 =3.85 years

or approximately 4 years

As long as the "competitor" is a diesel fuel boiler system (hotels, hotel apartments, apartment buildings and houses having central heating systems) the pay-back period rises to 7 up to 15 years.

In industry, the pay-back period is more than 10 years.

2.5 Standard Specificantions

The Cyprus Standards Organisation (CYS) has formulated two standard specifications relevant to solar heating:

a) "CYS 119:1980 Method of testing the performance of flat-plate solar collectors". For this purpose, a testing facility has been erected to test flat-plate solar collectors otudoors, similar to that adopted by CSIRO standard. This facility is controlled by the Energy Service of the Ministry of Commerce and industry which issues test certificates and collector performance characteristics.

b) "CYS 100:1984 Standard Specification for Solar Water Heaters". It deals with solar water heaters intended for domestic use and specifies the requirements for the materials, construction, marking and performance of solar water heaters using water as the heat transfer medium.

3. SOLAR SPACE HEATING

3.1. Relevant Socio-economic data

The climatic conditions in winter are such that space heating is needed for a period of 4—5 months and the average number of Degree-days (re 18 ^{0}C) for winter is 950.

For space heating, LPG is the most widely used form of energy followed by oil and electricity. Of the 1,000 households, included in the survey conducted in 1979 by the Statistics and Research Department, 59.6% used gas for heating (45.5% gas only, 14.1% a combination of gas with electricity, oil and wood), 28,8% oil (18.4% oil only and 10.4% a combination of oil with other forms of energy), and 9.5% wood (4.8% only wood). Wood is mainly used in the mountain areas.

8.9% of homes, mainly in coast and plain areas, did not have any form of heating. About 17.4% of households used more than one form of energy for heating, mainly gas with oil (5.8%), gas with electricity (3.7%), gas with wood (2.8%), gas with electricity and oil (1.3%) and oil with wood (1.1%).

3.2. Research and Development

Solar energy has not been put into use for the heating of buildings except from very few cases where solar active systems have been combined with central oil-fired heating systems and floor heating.

Research work on Solar Heating is carried out in the Higher Technical Institute (HTI), Nicosia. Reference is made to three relevant projects in this field.

(i) The HTI Experimental Solar Space Heating System (1983-85). The principal objective of this project was to design and install an experimental solar space heating system utilising low temperature solar energy for the purpose of finding out whether solar energy could be efficiently utilised for space heating in Cyprus and finally use the experimental installation as a demonstration unit.

The system designed is illustrated in figure 2. It consists of 7 solar panels having total absorber area of 9.3. m^2 tilted at an angle of 52 m^0 from horizontal, a 1000 litres storage tank equipped with heat exchanger, an auxiliary water boiler burning gas oil and all necessary controls and auxiliary components. Heat is distributed to the rooms to be heated in two ways: through fan coil unit in one room and through cooper piping embedded into the floor screed in another room.

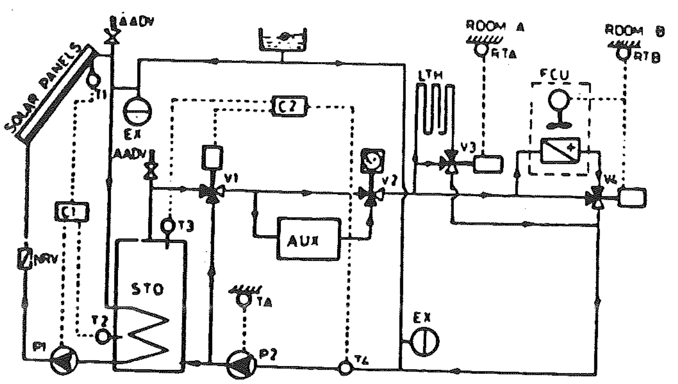


Fig. 2. Schematic diagram of the HTI experimental solar heating system

STO	:	Storage tank
AUX	:	Auxiliary heat source (hot water boiler)
P1,P2	:	Circulating pumps
C1, C2	:	Temperature differential controllers
RTA RTB	:	Roome Thermostats
EX	:	Closed expansion tank
V1,V3,V4	:	3—way motorised values ON-OFF
V2	:	3-way mixing value (optional)
T1,T2,T3		
T4	:	Temperature detectors
TA	:	Ambient emperature detector
AADV	:	Automatic air discharge valve
NRV	:	Non return valve
LTH	:	Low temperature heating (floor)
F.C.U.	:	Fan-coil unit

The results obtained from extensive tests carried out during the heating season of November 1984 to March 1985 were in fact interesting for that type of building used i.e. office rooms, but can not be considered as satisfactory and encouraging for residential applications where the daily heating period is longer.

The percentage solar contribution to the space heating demand was very high (90-100%) during the period of March and November, when the ambient air temperatures were around 12-15^0 C and with water flow temperatures of about 40^0 C. Under these conditions the heating requirements could be satisfied fully without or with very little auxiliary energy supply.

For ambient air temperatures lower than 12^0 C solar heating can be effective if boosted by the auxiliary boiler, provided that the water flow temperature does not exceed 40 - 50^0 C. However, with floor heating and intermittent operation, this didn't prove correct and in fact with low water temperatures the heated floor could not satisfy the heating requirements of the room for various reasons, the most important being the very high value of the room Specific Heat Loss Coefficient G (3.45 $W/m^{3\,0}$ C), as a result of which the radiating surface (floor) was perhaps insufficient to satisfy the heat requirements of the room. Possible increase of pipe length could bring about higher costs. The problem can be solved by simply improving the lagging efficiency of the traditional building structure and thus bring the G value down to a reasonable value of not higher than 1.5$W/m^{3\,0}$C.

The overall solar contribution for the test period of Nov. 1984 to March 1985, was estimated to about 30% (approximately 90% for November and March and very poor, about 20%, for the other months. The low percentage estimated for the months fo December, January and February is mainly due to the fact that for most of the time, especially with low ambient air temperatures, this, the water returning from the rooms very rarely was going through the storage tank and thus the utilisation of the solar heated water was very little.

However, there are good reasons to believe that with a G value of about 1.5 $W/m^{3\,0}$ C, and with water flow temperatures around 40 to 45^0 C the percentage solar contribution to the heating demand of the test rooms could reach the value of 70% and thus bring about a considerable saving in fuel consumption. What is actually needed is much improvement in the thermal characteristics of the building structure.

(ii) Passive Solar Heating

A 20 m^2 external wall of a classroom facing south was modified to act as a solar collector (Trombe wall) to collect solar radiation and transfer it into the room for heating purposes. Tests conducted during the heating season of 1985-86, at class working hours, lead to the conclusion that the overall solar contribution was about 60 to 70% of the classroome heating requirements.

(iii) Prototype Solar House

Following the experience of the Experimental Solar Heating System, which was purely active system, the HTI has undertaken to design a prototype Solar House in Nicosia. This house was designed to satisfy its heating needs primarily by passive methods (good insulation, large glazing facing south, overhangs for shading in summer, etc.) and be assisted by a small number of flat-plate solar collectors connected directly to the heat-emitter which is piping embedded into the floor screed. In the case of poor sunshine, the heating will be accomplished by individual mobile gas heaters. The above approach seems to be very interesting as the capital investment is much lower than tradditional active systems employing water storage tank, heat-exchanger, and oil or gas boiler as auxiliary.

3.3. The prospects of Solar Space Heating

The use of solar energy for space heating does not appear to be economic under the conditions prevailing in Cyprus, as a result of:

a) Very high investment cost (necessity of sophisticated solar collectors and heat distribution system-air or water-).

b) High complexity of installation in existing buildings.

c) Short annual duration of optimal use leading to high depreciation cost and pay-back periods.

d) Very low impact on Cyprus energy saving.

However, solar passive design of new buildings is one of the most important components on energy conservation action in the residential and commercial sector.

3.4. Solar Heating of Greenhouses

The total area covered by greenhouses is 100 hectares, (10^6 m^2). The average solar radiation incident on a horizontal surface during the heating season is about 3.4 kWh/m^2 /day. Assuming an efficiency of solar energy collection (passive) at the conservative value of 10%, the solar energy utilised by the greenhouses for heating is 10^6 x 3.4 x 120 x 0.1 kWh/year or 41 million kWh/year; thus, greenhouse heating by solar energy saves about 41×10^6 kWh x 0.125 tons/1000 kWh = 5,125 tons/year of oil which is equivalent to 0.5% of national energy consumption.

Greenhouses are employed mainly for off season production of vegetables in Cyprus and heating is usually required in the night during the winter months. Investigations on the application of solar energy for heating greenhouses began in the late 70's and were expanded and intensified from 1981 with the initiation of the ARI (Agricultural Research Institute) / GTZ (German Agency for Technical Cooperation) joint project on solar greenhouse heating. Beginning from 1981 there was development, evaluation and testing of solar greenhouse heating systems. The works were carried out at the ARI in Nicosia and included solar air and water collectors, water and rock bed storage systems, simple low grade heating systems for greenhouses, curtain heat exchangers for heating and collecting, passive solar systems of water-filled plastic tubes and a pond collector. As all these systems are used only for a relatively short winter season (3 to 4 months) one of the major aims is to build very cheap systems wiht high efficiency. An effort was made to use only locally produced materials and make simple designs so that farmers would be able to construct major parts or all the systems themselves. The performance of the systems was monitored at the institute by a micro-processor supported data-logger and evaluated for at least one complete season. Some of the systems have been transferred to commercial farms in the major agricultural regions of the country and tested under practical conditions. The work is going on.

NOTES

(1) This coefficient takes into account all system heat losses.

(2) This coefficient assumes that the consumer's hot water demand pattern is not fully matched to the solar hot water availabilities (excess solar hot water without any "value").

(3) This coefficient takes into account that part of the present SWH stock is not optimally used: SWH under repairs, SWH oversized compared to consumer needs, houses and flats unnoccupied, for various reasons, etc.

(4) This estimate for 1983 should be considered on the low side taking into account the vcery cautions assumptions which have been retained in the absence of significative and reliable actual field measurements.

(5) 1 kWh delivered to the consumer equivalent to about 0.34 kg of HFO (98% of existing SWH are installed in houses or flats saving electricity) - the ratio 0.34 kg/kWh should decrease in the future.

REFERENCES

1. "Renewable Energy and Energy Conservation Project Energy Planning and Data Base Subproject"

Reports by SEMA—METRA & KITTIS ASSOCIATES LTD to the Minbistry of Commerce and Industry, Republic of Cyprus (1984)

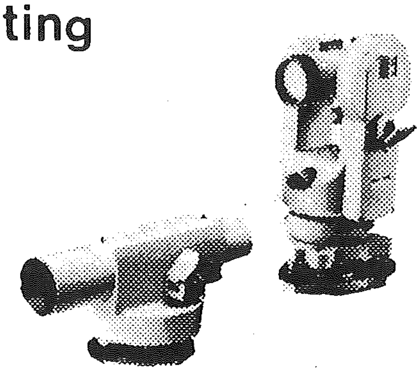
2. "Solar Energy Utilisation in Cyprus". Technical Report by I. Papadopoulos, Energy Service, Min. of Commerce and Industry

3. "Creenhouse Heating with Solar Energy" State of the art study of the CNRE, F.A.O., Rome (1987) by C.V. Zabaltitz (Editor)

4. "Performance of the HTI Experimental Solar Heating System", Technical Report by I. Michaelides, Higher Technical Institute, Nicosia (1985)

5. "CYS 119:1980" and "CYS 100:1984" Cyprus Standards Organisation, Min. of Commerce and Industry

6. "Solar Radiation and Sunshine Duration in Cyprus" Paper N. 10 Meteorological Service, Min. of Agricultute and Natural Resources (1985)



HOLOGRAPHY AND ITS APPLICATIONS

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INTRODUCTION

Holography is a method of recording and then reconstructing waves invented by D. Gabor in 1948. The word"holography" originates from the Greek word "holos" meaning "the whole". By using this word the inventor of holography wanted to stress that it records complete information about a wave both about its amplitude and its phase. In conventional photography the distribution only of the amplitude (more exactly, of its square) is recorded in a two dimensional projection of an object on to the plane of the photograph. For this reason when examining a protograph from various directions, we do not obtain new angles of approach and we cannot see for example, what is happening behind objects in the foreground.

The most striking feature of any hologram is the three dimensional image that it forms. An observer looks through a hologram as if it were a window. A three dimensional image of an object can be observed to be on either side or even straddling this window. As the viewer moves his head up and down, and side to side, he can look around the object. In fact what is observed is not a psychological effect but can be confirmed by instruments such as cameras or video recorders. This means that the light arriving from the hologram, into the viewers eyes is physically the same as the light emitted from the original object.

If a hologram is broken into small pieces (or if the hologram is covered by a piece of opague paper with a small hole in it) the entire image can be seen through any small piece. Depending on the location of the piece viewed the perspecture is changed. This resembles precisely the act of looking through a hole in a covered window. Depending on the location of the hole the outside scene is perceived in its entirety, but from a different perspective.

The physical foundation of holography is the science of waves their, interference and diffraction. At the beginning of the 19th century T Young, A Fresnel and I von Fraunhofer had already sufficient knowledge to formulate the fundamental principles of holography. This did not occur however up to the work of Gabor who was able to formulate the idea of reconstructing a wave-front and indicate how to carry it out with complete definetenes. The difficulties however with the preparation of holograms remained so appreciable and holograph developed so slowly that by 1963 Gabor himself "almost forgot about it".

In 1963 E Leith and J Upatnieks prepared laser holograms for the first time. A year before this they, proposed the "split beam" or "two beam" methods which considerably improved Gabor's original arrangement. From this time holography began to develop at a very rapid rate and at present up to 1000 publications devoted to it appear every year.

Multiple-beam, holograms:

Fig, 1 shows one of many possible configurations for forming two beam holograms. The laser beam is directed to the right by mirror M and is split into two by the beam splitter B.S. With a white card-board acting as a screen at the location of the future holograms the reference bean can now be aligned by M_2. The object to be used can now be located in front of the screen and is illuminated with the object beam directed on it by M_2. Before spreading the beams the optical paths can now be approximately equalized by the adjustment of the mirrors M_2 and M_3. A lens L_1. can now be introduced to expand the reference beam. Similarly the lens L_2 diverges the object beam to illuminate the object uniformly. The beam ratio can be mesured by blocking one beam at a time and the intensity of each can be checked with a lightmeter.

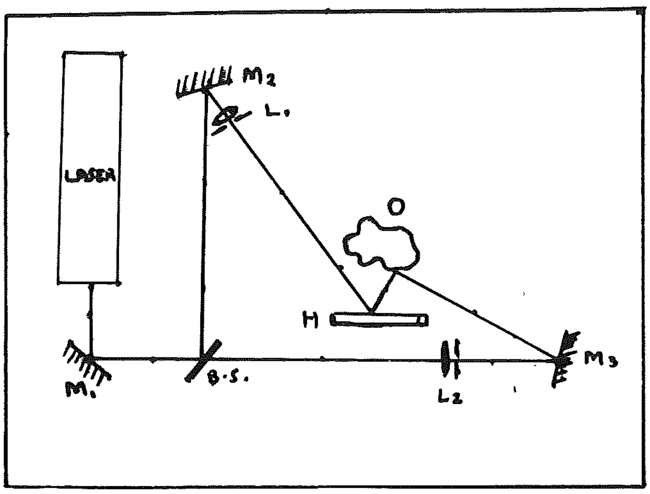


Fig. 1

The intensity ratio between the reference and-the object beams should be approximately four to one.

When the two parts of the beam reach the photographic plate or the film, they interfere that is joined together to form an additive pattern. At points where the wavetrains of the two beams meet in phase their amplitudes add to give greater intensity of light than that produced by either alone while at the points at which they are exactly out of phase they partly cancel each other out. At intermediate positions the amplitude of the combined pattern falls between these two extremes. It is for this reason that lasers have stimulated the recent explosion of interest in holography: they are the only strong sources of light which are sufficiently monochromatic to form useful interference patterns. The photographic plate thus records the interference pattern between two beams of radiation. On developing the plate the hologram will appear as a mass of rings whorls and specks but the interference pattern itself may be mat and featureless, particularly if the illumination of the object was diffused. The rings and so on may be only imperfections of various kinds but in any case the hologram bears no obvious relation to the original scene. However if it is illuminated by a laser beam two images of the original scene appear -one real image which can be photographed directly and the other a virtual image which can only be pho-otographed using a lens (Fig. 2)

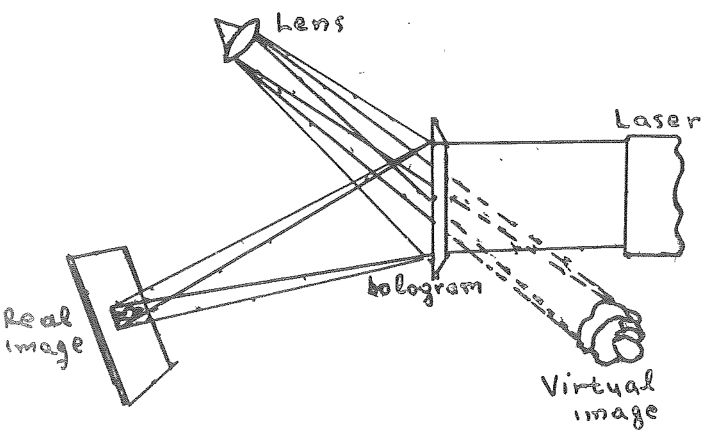


Fig. 2

Apart from the fact that the virtual image appears a little speckled both images are optically identical with the original scene hence the viewer can choose a plane to concentrate on and then transfer his attention to another plane, just as he could with the original scene focusing his eye on one .plane or another. Hence the viewer sees the reconstructed scene with true binocular stereoscopic vision.

It is also possible for the same scene to be recorded using lasers at different wavelengtns if three colours are used, for example red, green and blue the scene can be viewed in effect in natural colours. The reproduction is at three discrete wavelengths but the effect on the eye is much the same as natural colour. However there would be difficulty in separating the real and virtual images of the three colours but fortunately it has been found possible to avoid the confusing "pair of images" and produce only one image which may be real or virtual. The technique depends on making use of the finite thickness of the photographic emulsion. Such holograms may be referred to as 'thick' to distinguish them from the thin two-image holograms. In fact thick holograms can now be reconstructed in natural colours using ordinary white light.

Applications of holography

The peculiar and unique features of holograms can lead to a number of important uses and like photography has both scientific as well as artistic applications.

a) Holometry or holographic interferometry

Holometry can be divided into three classes: double exposure, time average and real time. In double exposure a hologram of the object is taken it then allows the object to change microscopically and then making a second exposure. In the second case only one exposure is made while the object is under steady-state vibration. The nodal areas that did not vibrate will appear bright whereas the antinodol areas where the object shifted will appear dark. Finally real time interferometry involves exposing a hologram and viewing it in its original location so that both the image and the real object are superposed in space. If the object now shifts dark fringes will be seen through the hologram. They are caused by the differences between the location of every point on the object during exposure and its present locations.

b) Holographic strain analysis

Consider a diffusely reflecting object that has undergone a deformation. The interpretation of the interference pattern resulting from this deformation is the central problem in holographic strain analysis. If the microstructure of the surface of the object does not change during the deformation it is then possible to calculate the phase difference between waves from corresponding points in the-two images as a function of the displacement between these points.

c) Holography and the car design

An important merger of computer and holographic technology is taking place in the Massachusetts Institute of Technology. Holograms are being made that provide true three dimensional representations of graphics stored in a computer. The General Motors is backing the three years project led by S. Benton an associate professor at M.I.T. and although the project is still in its early days Benton believes that the holograms could cut the time taken to design a car from five to one and a half years. Currently designers make drawings and clay models of the car being designed. The new holographic technology could virtually eliminate these lengthy processes. Another advantage is that the data stored in the computer which define the hologram of the car can be used to help engineers to set up a computerised manufacturing process. The team at M.I.T. has developed "alcove" holograms. These are quite different from their better known counter parts. To make "alcove" holograms, the computer calculates now a three dimensional object which would appear from various viewpoints and they generate two-dimensional projections of the object's appearance from different angles.This in itself is not new but what is new is the way in which the two dimensional image are manipulated to create the three dimensional holographic image.

An important innovation of alcove holography is that the hologram looks as if the viewer could reach out and touch the image (Fig. 3).

Images do appear in front of some flat holograms but the holograms flatness and limited size restricts the viewing angle. Move to one side and the three dimensional image disappears. Because the hologram curves through 180^0 the three dimensional image stays in view as long as the viewers line of sight includes the hologram.

The team is also trying to develop large-scale images so that it can produce an alcove hologram 1 metre high and 2 metre across.

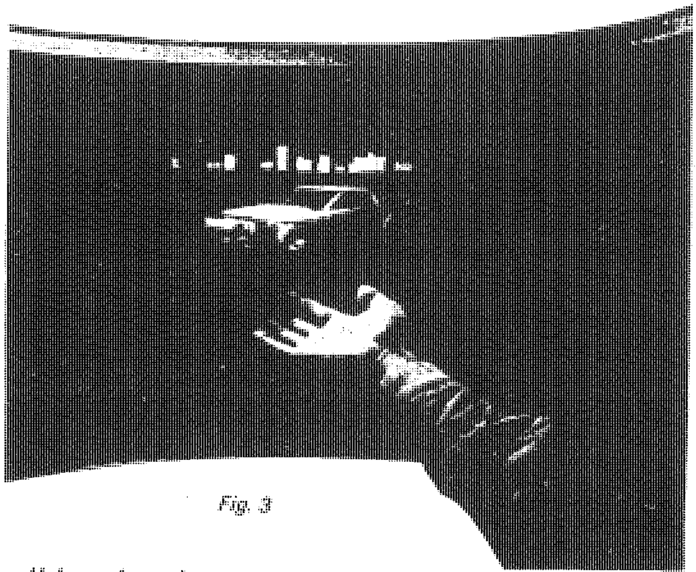


Fig. 3

Holography and computers combine to produce the image above, which should help car manufacturers cut design times

d) Holography and art

Pictorial art since the Renaissance has mimicked a third dimension with rules based on a knowledge of perspective. Holography dispenses with the need for an art convention to pack three dimensions into two, operating with total conviction by an ingenious manipulation of light and projecting a third dimension where, in a tactile sense none exists. The holographic image may appear either in front of or behind the holographic plate, or may protrude from it partly behind, partly in front. Holographic images created by coherent light from a laser may hover in space as if by some magic.

Holography as a true art form has been effectively demonstrated in Coventry cathedral where M. Woodward created a series of sculptures on a religious theme "Stations of the Cross" which were then recorded as holograms for permanent display. The company concerned. "Anvanced Holographics", is an acknowledge leader in the quality of its work. It makes display items that are viewable under white light and they have produced really quite startling improvements in the displays which overcome some of the difficulties of holography by making the images easily viewable

e) Data recording

One British firm has achieved exceptionally high densities of information storage for computer with a disc system which although not strictly holographic does use a surface relies effect and a laser recording process. This firm has introduced a new type of disc with a surface thinly coated in a continuous homogeneous film of platinum and patterned like the eye of a moth; the effect is achieved by laser interference techniques. The disc becomes like the moths eye black and non-reflective. A low power laser working as part of the computer set up then carried out thermal erasing to produce light reflecting shiny spots on-the disc, so giving a differential means of data recording.Each disc stores 600 megabytes.

f) Reactors

Others important industrial applications of holography are in the inspection of inaccessible or dangerous domains. At Aberdeen univeristy the technique is being developed for under water use in inspecting the surfaces of oil-rig supports. Vital signtings to determine whether the support has been buckled or corroded are obtainable in this way.

At the university of Kent experiments with optical fibres are assisting another form of inspection. In spite of a tendency of optical fibres to produce aukward phase errors it is possible to pass the image of a hologram down an optical fibre and then recreate it else where. The Central Electricity Generating board (CEGB) has devised a holographic technigue for inspecting unclear fuel elements (Fig. 4). The element is raised to an observation port but kept safely behind a radiation shield throughout the inspection. The technique depends on forming a hologram of the fuel element within the reaction which is possible without any fogging from the radiation. Backward illumination with a reference beam hologram, allows the image to be projected out of the hologram.

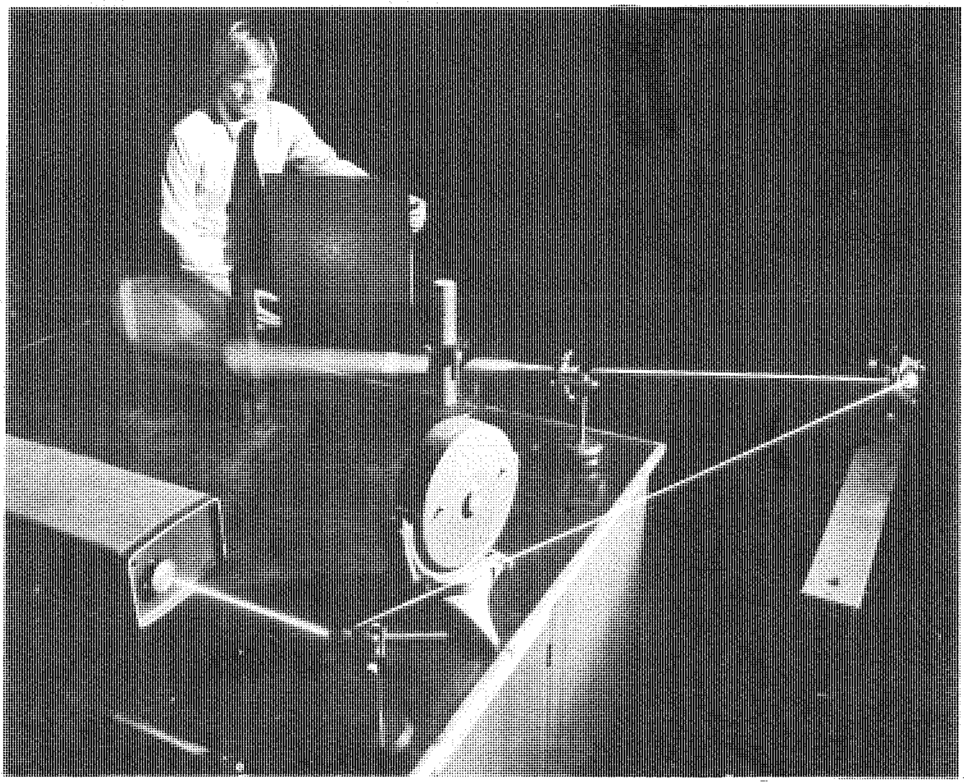


Fig. 4

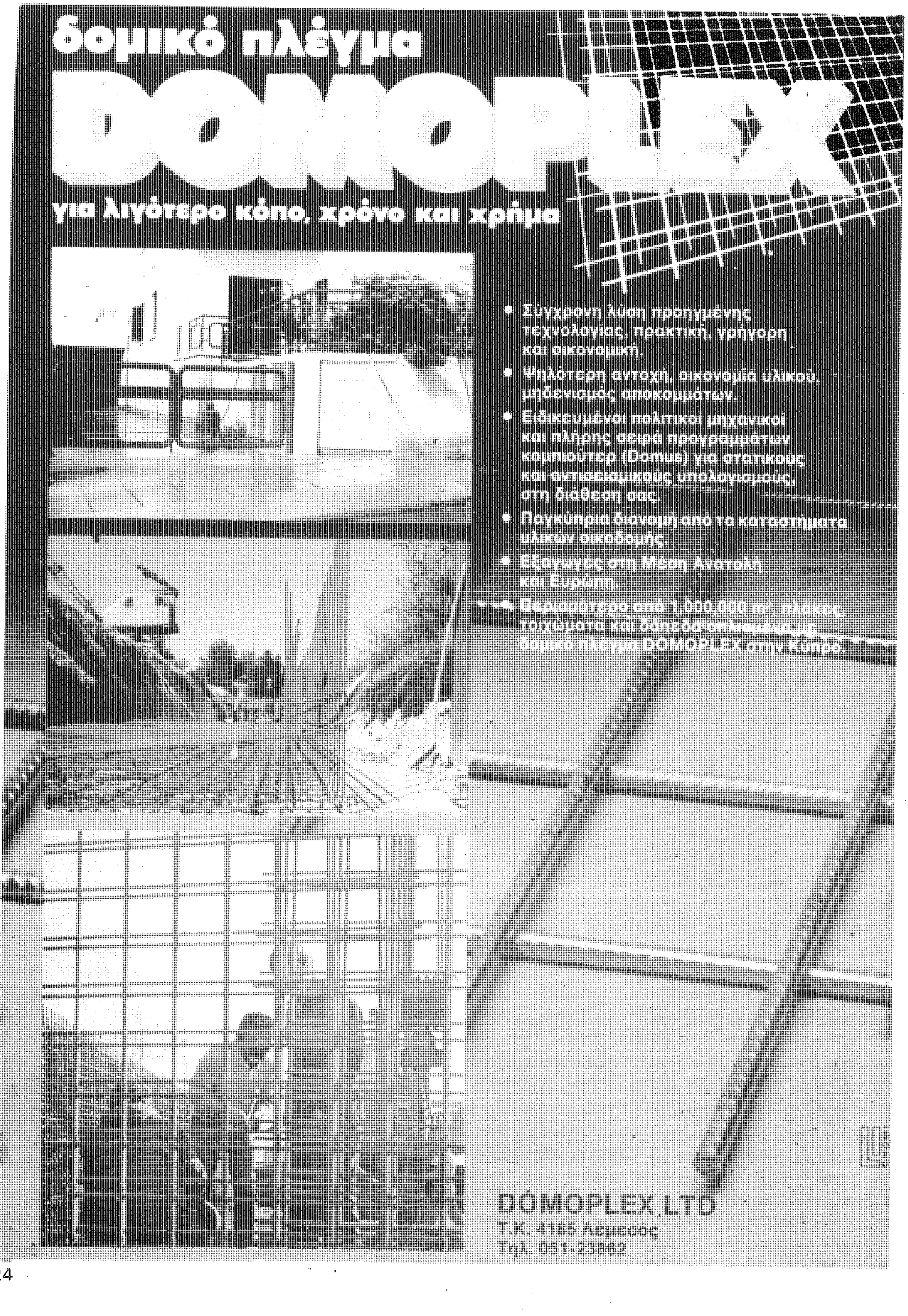
Projecting a hologram outside the danger area in an advanced gas cooled reactor (AGR) station. The fuel elements of the reactor are held in position by stringers, and this test can detect any deformation that may occur in the stringers through repeated expansion and contraction. (Photograph by the UK Central Electricity Generating Board.)

It is a real image and it can be more than a metre in depth. It can be examined out in the ain but is back-to-front. A television camera passes through the image to inspect it. The research is now well advanced and indendtedly a workable inspection method has been devised.

The distinctive characteristics of holograms can lead to a number of novel uses and somebody might well be thought that the present projects on holography look like a first step along the road to some still unimaginable future.

Bibliography.

1. Stroke G. W. Introduction to coherent optics and holography. Academic press.
2. DE Velis J B and G O Reynolds. Theory and applications of holography.
3. Caulfield H.J. and S. Lu. The applications of holography. Wiley Inter-science.
4. Cathey W.I. Optical information Processing and holography. Plenum press.
5. J. N. Butters. Holography and its technology I.E.E. monographs series 8 Peter Peregrinus London.



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COMPUTER GRAPHICS PROGRAMS FOR TEACHING MATHEMATICS

Austin R. Brown, Jr.

Computer graphics can be a powerful tool in learning mathematics. This note is a report on one product which I developed, with lessons to be drawn for the development and use of other products.

1. *The product.* ARBPLOT is a package of programs for exploring two-dimensional analytic geometry and geometry foundations and applications of differential and integral calculus. ARBPLOT was originally developed and marketed for the Apple II computer and now has been rewritten with improvements for the TI Professional and IBM-compatible personal computers.

With ARBPLOT you can

a) Plot a single curve in rectangular, rectangular parametric, or polar coordinate form.
b) Simultaneously plot two functions in rectangular coordinates, the second function either being independent of the first of being the inverse, derivative, antiderivative, or Taylor expansion of the first.
c) Geometrically show approximations to the definite integral by rectangles, trapezoids, Simpson's rule, a Monte Carlo technique, and Richardson extrapolation, as well as showing the geometric foundations for integration in polar coordinates or for arc length.
d) Show the process and find zeros of a single equation in a single unknown by three different methods.
e) Show several different limit processes including the epsilon-delta definition of the limit and the slope of the tangent as the limit of slopes of chords.
f) Use direction fields to show graphically the solution of first-order differential equations.
g) Illustrate graphically a number of features of sequences and series.
h) Explore the forms, shapes, and manipulations of conic sections in both rectangular coordinate (quadratic equations) and polar coordinate form.

ARBPLOT first appeared on the market in 1980, then in a major revision in 1982. It is in use in several hundred schools, colleges, and universities in the United States. Since its introduction several other competing products have appeared, some of them tied to specific calculus textbooks.

These program packages are frequently called *graphics utilities* to distinguish them from CAI, or computer-assisted instruction. The utility does not lead you through a course of study: it provides a tool to carry out the process which you have chosen.

2. *Using the product.* ARBPLOT was originally intended for use primarily as a classroom demonstration tool. The teacher would use large-screen video, either a monitor or projector, to illustrate points being made in a lecture. From that beginning, ARBPLOT and its competitors have been used by teachers to prepare hard copy for inclusion in class notes or from which to make transparencies for overhead projectors, and by students either in carrying out assignments or for exploration.

When should you use or refrain from using such a product? These products are best used to show the dynamics of a process, to show examples which are too complex easily to do manually, and to explore many different examples. They are least useful when the use of geometry seems artificial or when one simple static example is adequate.

Effective classroom use of these products requires more through planning and preparation by the teacher than does the conventional lecture/recitation mode of teaching. Students are much more aware of delays or ragged presentation when the computer is the presentation medium. Effective computer-based assignments must follow exactly the rules and constraints of the software being used.

Three simple curve-sketching applications of ARBPLOT are shown in Figures 1-3. Parametric representation of functional relations is a powerful tool of applied mathematics, yet it is usually given superficial treatment in calculus courses, with the same few simple examples such as the cycloid appearing in textbook after textbook. Figure 1 shows a Lissajous figure. Computer graphics helps you explore the effects of changing angle multipliers and phase angles, the period of the figure (PI radians or 2PI radians), etc. Figure 2 gives an example of exploring more general closed curves.

Similarly, polar coordinates can be studied quickly but more thoroughly than with strictly manual curve sketching. Figure 3 gives an example of an extension beyond the usual roses shown in calculus textbooks.

In examples such as these, the student learns better by observing the dynamics of the process rather than seeing only the static result.

Among the uses of ARBPLOT have been the

effects of changing parameters in families of functions, Gibbs' phenomenon in Fourier approximation, limitations in use of Newton's method for root finding, and left and right derivatives in functions with cusps, to mention only a few.

3. *Design.* Let us now turn to design considerations for such a package. Internally the programs should be designed, coded, and documented according to good modern structured programming practice. Externally, the design of each program should be user and subject oriented. The internal design should be invisible to the user. In current jargon, the package should be "user friendly".

Communication with the user should be clear, internally consistent, and consistent with the user's knowledge and level of understanding. The designer must know his or her subject, but equally important must know the audience and how to communicate with that audience.

Needed information must always be available to the user, including help when the user needs further amplification. Instructions and help should be simple and unobtrusive; the user should not be required to wade through unneeded information. Explanations should use concepts and terminology familiar to the user.

The program should be bug-free and foolproof. Bug-free means that the program has no errors; foolproof means that the program protects itself and the user from errors the user makes. It should react immediately to errors, but in ways and with information that keep the user always in charge.

Educational software differs from other software in that the educational program wll generally be used only once or for the short period of time required to learn a given subject. The user should need only minimum effort to learn to use the software. By contrast, more time can be invested in learning programs such as word processors or spreadsheets since the programs will be used over a long period.

How does ARBPLOT meet these design objectives? First, it is menu driven. Second, at any instant all needed information is visible to the user. Third, every program has a built-in example and every choice has a default. Fourth, all inputs and internal processes are checked for errors and corrective action taken.

Look at Figure 4, the main menu for the curve-plotting program which produced Figure 1. The ARBPLOT package has a master menu. When a program is selected, its main menu appears, as in Figure 4. All main menus have the same format. A title line appears at the top of the screen. Next we have up to six choices of values relevant to the particular program. The first choice is always the function(s) being used, including where pertinent the type of functional representation. The second choice is always the limits for the process, including where pertinent manual or automatic selection of scaling for the conversion from world to screen coordinates. Choices 3-6 are specific to the particular program, such as drawing the curve with solid or dotted line in curve plotting. Integration programs will have the integration method and number of subdivisions; root finding will have the method, etc. The current values are always shown on the menu; a built-in example is visible and available when a program is first called.

Choices 7-9 and O on the menu give the actions which can be taken, the same for all programs. Choice 9 is the process for the current program: plot, integrate, etc. Choice 8 gives a one-keystroke toggle switching the display between the menu and the latest graph. The internal method for toggling between menu and graph is quite different among the Apple II, the TI, and the IBM, but the user is unaware of the differences. The internal design is invisible to the user.

The ARBPLOT menus illustrate some of the "user friendly" design considerations. All needed information is always visible; current values are shown in the menu. Every choice has an initial value; you change only what you want to change. Format and use of menus is the same from program to program.

Similarly, the graph (Figure 1) shows all information needed for interpreting the result. Limits, important values, and the function (s) are shown along the left side of the screen. If the viewport has been chosen to show only a portion of a graph, the true limits of the variables can be seen on the left while the size of the graph is shown on its borders.

Menus are not the only means for displaying choices. Prompt lines at the top or bottom of the display screen can also be used. Prompt lines can always be visible yet unobtrusive, but they are limited in the amount of information they can give. Some modern computer designs such as in the Apple Macintosh and Commodore Amiga combine prompt lines and menus with "pull-down menus" summoned from and disappearing into a prompt line. They also permit the use of a pointing device called a *mouse* to make selections, rather than requiring a specific key to be pressed.

Good programs must also be foolproof. All input and all calculations must be checked. ARBPLOT has a special error-checking input routine and error trapping on all internal operations. When the program can correct an error, it does; when it cannot, it tells the user what happened and what action is needed.

How do you create high-quality user-friendly software? You start with careful design. Know your subject, know your audience, then use structured design and good programming style. Having started with good design, the key to a quality product is testing. Successful testing depends upon attitude. You must assume your program has errors; you must assume it has points at which it is awkward or not clear. The purpose of testing is to find and remove the errors and deficiencies, not to demonstrate that your program is perfect.

After you personally have tested the program as thoroughly as possible, you must enlist others. Testing should involve as many types of users as possible: the expert and the novice, the careful-nd the careless, the suspicious and the trusting, the malicious and the supportive. Once past the testing hurdle, you are ready to turn your program loose on students. A new level of testing begins, testing the pedagogy of the software and its use.

Computer graphics can be a great help in learning some parts of mathematics. Quality programs are available for some subjects and can be written for others. Care must be taken in developing the software. Care must also be taken in using the software.

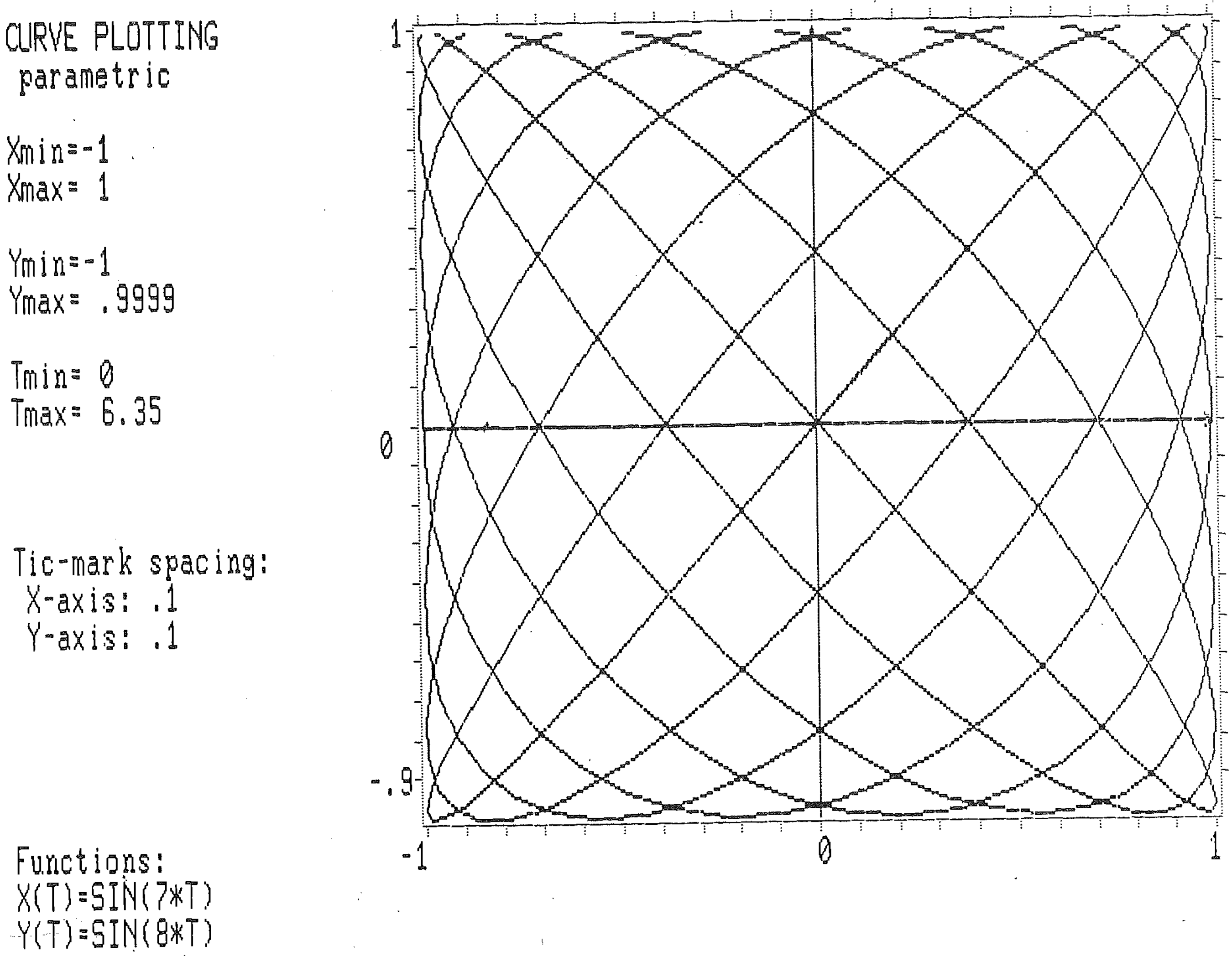


Fig. 1

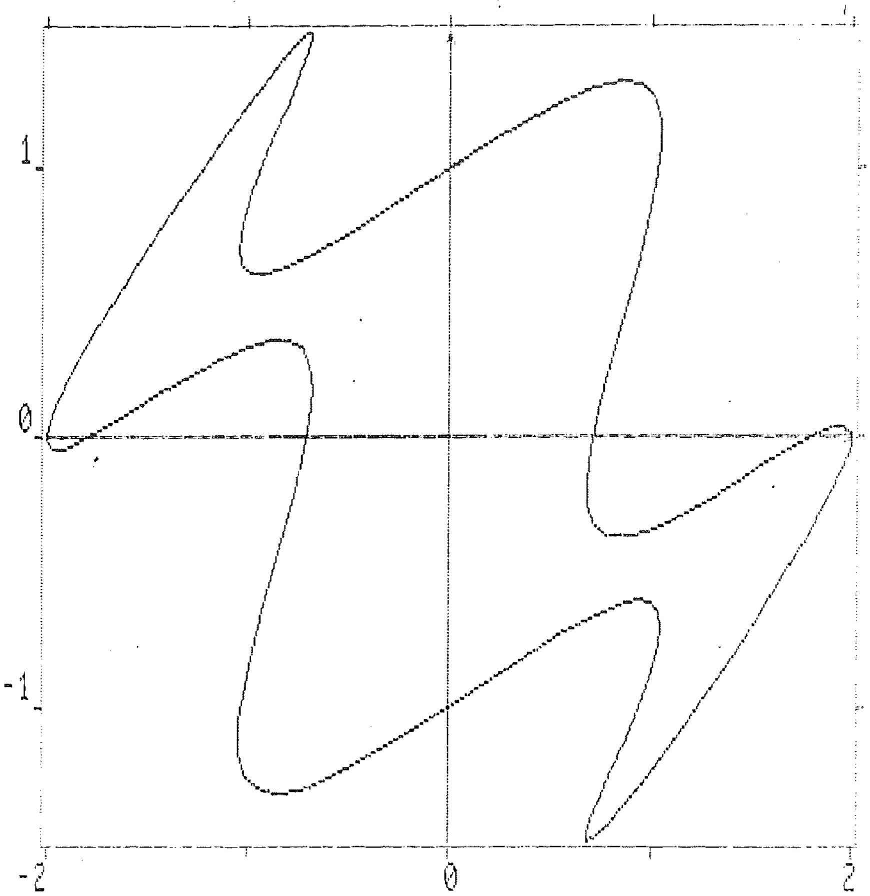
CURVE PLOTTING
parametric

Xmin=-1.999
Xmax= 1.997

Ymin=-1.501
Ymax= 1.5

Tmin= 0
Tmax= 6.3

Tic-mark spacing:
X-axis: 1
Y-axis: 1



Functions:
X(T)=SIN(T)+COS(2*T)*SIN(3*T)
Y(T)=COS(T)+SIN(2*T)*COS(3*T)

Fig. 2

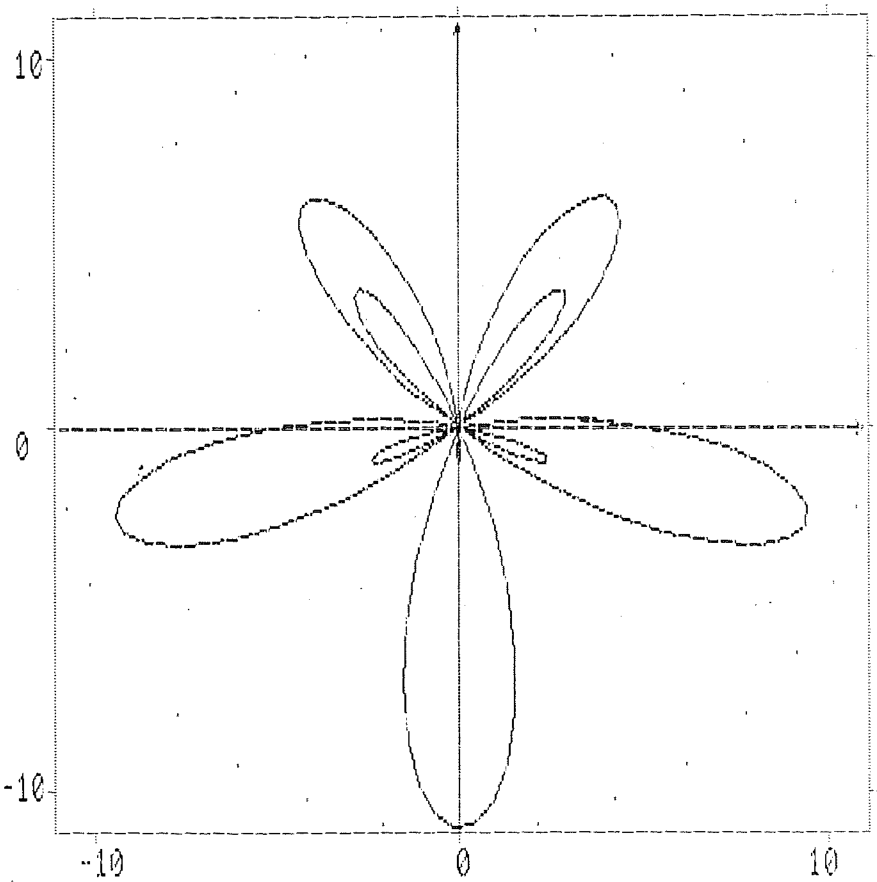
CURVE PLOTTING
polar

Xmin=-9.203
Xmax= 9.443

Ymin=-10.86
Ymax= 6.249

Rmax= 10.99

Tmin= 0
Tmax= 6.4
Tic-mark spacing:
X-axis: 10
Y-axis: 10



Function:
R(T)=3-6*SIN(5*T)+2*COS(4*T)

Fig. 3

```
              >>ARBPLOT2 - CURRENT VALUES AND CHOICES<<

1. Function: rectangular parametric
    X(T) = SIN(7*T)
    Y(T) = SIN(8*T)

2. Limits:
    Tmin=  0.000    Tmax=  6.350    dT= 0.0200
    Xmin= -1.000    Xmax=  1.000
    Ymin= -1.000    Ymax=  1.000
   Manual and independent SCALING


4. Screen: CLEAR present display
5. Curve: SOLID  line
6. Axes: SHOW
 ACTIONS:
7. Save current display (disk or printer)
8. Show current display
9. Plot curve
0. Exit
 CHOICE: Change value (1-6)
         Act(7-9 or 0)
                          WHICH(0-9)?
```

Fig. 4

IS ARTIFICIAL INTELLIGENCE (IA) THE NEXT LOGICAL STEP IN DATA PROCESSING?

Christos Schizas, BSc, PhD, CEng, MIEE, MIEEE, FABAC

We haven't seen the expert systems of the fifth generation of computers yet, and computer experts and researchers are already talking about the "sixth generation" of computers.

The Japanese are preparing to launch a three billion pounds program called the Human Frontier Science Program. One Part of the program will entail development of a "sixth generation of computers". The program is expected to merge research and development of AI with studies of the functions of living organisms, and will include research on "everything from new machine architectures that imitate the paralled processing capabilities of the human brain, to biochips". The objective of the program is aimed at creating a new example for science and technology capable of harmonizing mankind with nature. Overall the program is aimed at developing systems that are "more like human thought than what we call expert systems". In order to give the right magnitude to this emphasis, recall that early computers were dealing in terms of zeros and ones. Systems built later used letters and numbers as input, then pictures and graphs. In sixth generation computers robots become part of the way we think of the computer.

What is Artificial Intelligence? And how does it relate to expert systems? It is generally accepted that AI is the broader term, encompassing both practical expert systems and the science concerned with modeling human intelligence (congnitive science). Yet computer scientists are not totally agreed on the definition of AI. This is not surprising, given the difficulty of defining natural intelligence. Human intelligence, or the practical application of knowledge, covers the collection and classification of knowledge,its selective retrieval, and its processing to yield some usable result, as, for example, in making a decision to take a certain action.

Human knowledge, it seems, is based not only on immutable facts but also on learned experience, which is not always related to truth and logic. And instinct may also play a role. How does one go about assembling a body of knowledge so that it can be efficiently used in making decisions?

A fundamental first step is the organization of facts that move into some logical format which can be very easily developed if we are dealing with pure science. This system of identification is called taxonomy, and the closer a discipline moves to the real world of application, the more ill-defined its taxonomy becomes. Nevertheless, an approximate taxonomy is needed to take the next step-namely, to extract from the taxonomy the facts and inferences needed to reach a decision. The algorithms for selecting and then manipulating the needed facts and inferences are crucial-they help constitute an expert system.

How good an expert system is can be judged perhaps by analogy to a human expert. One might examine the process by which a young medical doctor reaches a decision and compare it with process used by an experienced mature doctor. A decision tree needed by the former would usually be complex and many-pathed, whereas a decision tree used by the latter might be so truncated as to be unrecognizable. The mature doctor will take shortcuts based on experience and probabilities. Social scientists might say the mature exploits a "schema" to settle on a diagnosis so quickly. A schema is the organization of experience in mind or brain.

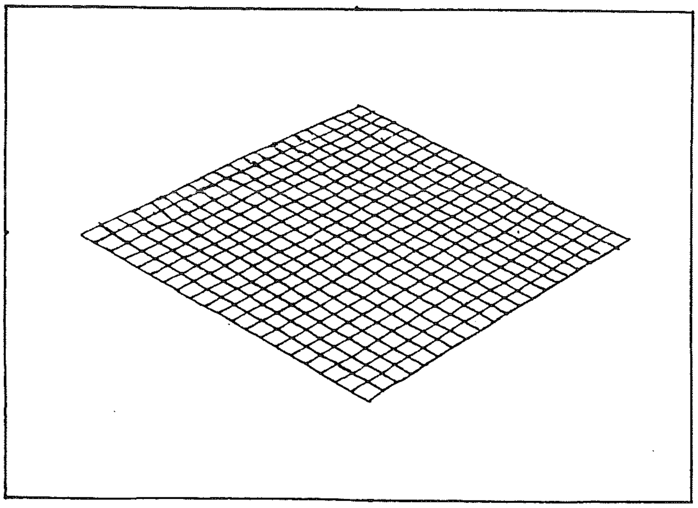
We can try to illustrate the relationship between a taxonomy and a schema in a simplistic but graphic way. Assuming that a taxonoy can be represented by a simple matrix, and facts or events by the matrix intersections or nodes, then each node can be elevated along the Z-axis in degree or significance in relation to some larger circumstance or scenario. In the case of a medical scenario, the nodes might represent symptoms.

The expert, human or otherwise, would, in effect, compare a three dimensional profile representing some real situation or circumstance against profiles in library of known, probable scenarios that constitute the relevant schema. An experienced human would make the match quickly, as would a superior algorithm in an expert system. A good match in the medical example could yield a diagnosis and a suggested schedule for treatment.

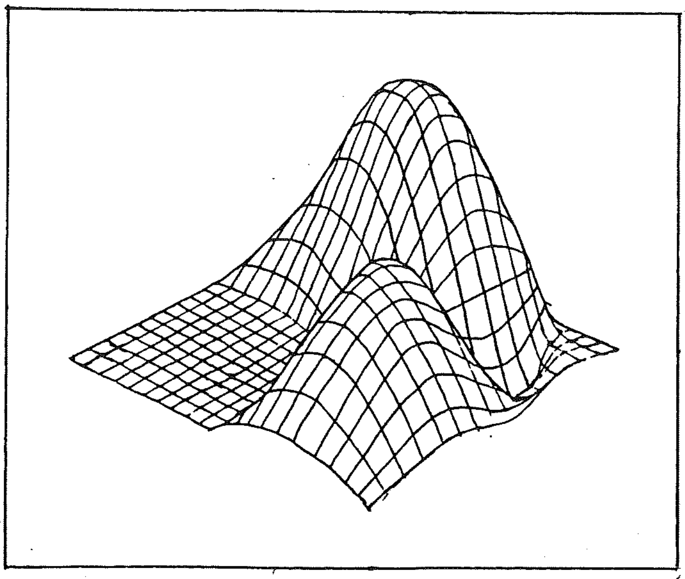
Expert systems are in their infancy. It remains to be seen for which applications they will prove to be most useful. As they now exist, they are applicable to some narrowly focused task in which the knowledge base is well developed and the rules for reasoning are well defined. On the other hand, one of the most powerful expert systems may turn out to be an expert system to design expert systems. Such a system could be useful at several stages. It might be brought to bear on the organization of information in any field, discipline, or subdiscipline; on the development of appropriate schema; and on the development of algorithms for decision making.

Put in another way, instead of developing expert systems independently of one another, the emphasis might better be put on the methodology of developing expert systems. Such research could pay off in the longer term. It might draw upon the results of studies by computer scientists of how the human brain functions. It would involve methods for indentifying, organizing, classifying, evaluating, and screening information and literature pertaining to a given field or subject to create an approximate taxonomy. It would also involve methods of accessing pertinent parts of that information base for use in solution/decision algorithms. Some algorithms might be useful at a macro level; for example, developing a reading list of scientific/technical information relating to a particular problem. Other algorithms might operate at a micro level, selecting a particular technical solution or a specific diagnosis from among several possibilities. Even with the aid of such a powerful system, however, there is little fear that the human expert will be made obsolete. He or she will have to make judgements on the size and boundaries of source databases, on criteria by which information is discounted or screened out, and on criteria for algorithms by which decisions are made, to name but a few of the more important roles. The human expert will need to update the expert system - in effect, to provide it with "continuing education", a necessity with which the human expert is thoroughly familiar.

Taxonomy



Schema



MODULA - 2: A SUPER GENERAL-PURPOSE PROGRAMMING LANGUAGE

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Introduction

MODULA-2 is a PASCAL-based general purpose programming language written by the inventor of PASCAL, Nicklaus Wirth. While it includes PASCAL's general utility and clarity (to which PASCAL owes much for its popularity), MODULA-2 extends PASCAL in the following ways:

1. It supports the concept of a module
2. It uses a highly systematic syntax
3. It makes use of the concept of PROCESS, which is the key to multi-processing systems.
4. It provides low-level facilities

Thus, MODULA-2 is suitable for programming entire computer systems, from high-level machine-independent software to low-level machine-specific software. By making use of the module facility, large programs can be constructed from smaller, separately compiled parts (modules).

MODULA-2, is likely to become popular mainly due to the following:

1. Centers for software development can now use a single language for the large majority of their projects.
2. The transition from PASCAL to MODULA-2 for recent university graduates will be made possible without extensive training.
3. The placement of generic modules in libraries will prevent the rewriting of already existing code.

In this paper, we shall make an attempt to present the facilities provided by MODULA-2 but not by PASCAL. First, we present the module concept. We then proceed to describe how the multi-processing facilities provided by MODULA-2 are suitable for the programming of certain types of real-time systems. We conclude with the low-level facilities that are required for device handling.

1. The Module Concept

Modules are the most important feature distinguishing MODULA-2 from its ancestor PASCAL. Programs are partitioned into modules, each module containing objects such as constants, variables, procedures, and perhaps types. Objects declared in other modules can be referenced in a module M, if they are explicitely made to be known in M i.e. if they are imported into M. Modules are developed and compiled separately and stored in object/compiled form. Upon program loading, the compiled main program is linked (joined) with the precompiled modules from which it imports objects.

Most often, the software for a relatively complex system is organized as a hierarchy of layers. In the actual implementation, each layer would be implemented as a module providing services to the layer immediately above. Such services might include procedures, types, constant values. The main motivation behind the partitioning of a program into modules is the establishment of a HIERARCHY OF ABSTRACTIONS/LAYERS.

With layering, the layer above may wish to call the procedures of the layer below, but should not need to know how these procedures are implemented. By hiding the details of the module providing services, the objects of the latter module are protected from outside access. As an example, consider a module used to implement a stack. The operations allowed on a stack are PUSH (to "push" an element on top of the stack). POP (deletes the element that was last "pushed") and INIT (initializes the stack to be empty). These routines are implemented in and exported by the stack module; access to a stack data structure is possible only through them. Another important reason for hiding the details, is to make it possible to change the coding of a procedure being exported without having to recompile the modules importing that procedure.

Thus, if modules are to be supported, provisions must be made for the textual separation of the ESSENTIALS of a module from its DETAILS. The essentials of a module is that information about objects (procedures, types, etc) that are imported by other modules; the details are those parts that are to be hidden and protected. In MODULA-2 this separation is made possible by splitting a module into a DEFINITION part and an IMPLEMENTATION part. The objects that are available for export are specified in an EXPORT list. The export list is in the definition part that also contains the declarations of the exported objects. If a module I wishes to import from module M, then it is only the definition part of module M that it needs to have available (so as to ensure that what is imported is actually exported by M). If the implementor of module M changes the implementation part only (for example, using a linked representation in place of the array implementation) then module I need not be changed or recompiled.

```
DEFINITION MODULE Stack;
  EXPORT QUALIFIED Pop, Push, Init, Empty, Stack Rec,Max StackSize;

  CONST MaxStackSize=1000;
  TYPE StackRec;

  PROCEDURE Pop (VAR S: StackRec;
                 VAR PoppedValue: INTEGER;
                 VAR UnFlow: BOOLEAN);
  PROCEDURE Push (VAR S: StackRec; Value: INTEGER;
                 (VAR OvFlow: BOOLEAN);
  PROCEDURE Empty (S: StackRec): BOOLEAN;
END Stack;
```

From above, we see that module "Stack" exports four procedures, one type and a constant. Any other module importing from "Stack" will most probably import the type "StackRec" so as to declare variables of that type; these variables will subsequently be manipulated via the imported stack procedures. Note that the "StackRec" data type is exported in so-called "opaque" mode. This means that the full declaration of the "StackRec" data type is not visible in importing modules; the full declaration is given, and is visible only, in the implementation part of the exporting module. Consider what could go wrong if the following full declaration were given instead:

```
TYPE StackRec=RECORD
      S      :ARRAY [I..MaxStackSize] OF INTEGER;
      Top   :[0..MaxStackSize]
    END;
```

A module importing the "StackRec" data type and declares variables of that type is permitted to reference and/or modify the fields of the declared stack record variables. During debugging, the implementor might decide to manipulate the fields of the declared stack variables directly (rather then through the procedures imported from the "Stack" module). The implementor might suspect that the module does not work correctly because the error is in the implementation of the imported stack procedures. Consequently, instead of using the INIT procedure to initialize a stack variable S, the assignment statement "S. Top:=1" could be used instead. Of course, this will most probably create even more errors and perhaps the implementor might decide to continue the direct manipulation of the stack variables S.

The central point here is that even though the error was originally in the module being implemented, the error search space had been, unnecessarily, extended into the "Stack" module simply by providing the implementor of this new module with the freedom to manipulate the stack variables directly.

We will now give the implementation part of the "Stack" module. Objects that are fully declared in the definition part, are automatically visible in the implementation part for that module. Objects exported in opaque mode, are fully declared in the implementation part. It is important to note that opaque types are restricted to pointer and subrange data types. Import lists specifying the modules from which objects are to imported along with the actual objects imported from each module are also included in the implementation part. The latter concludes with a block of statements enclosed inside a BEGIN-END pair. These block serve to initialize local variables before actual execution of the main module. (In the example below there are no local variables to initialize and a message is instead echoed).

```
IMPLEMENTATION PART Stack [1];
  FROM Terminal IMPORT WriteString, WriteLn,...;
  FROM Storage IMPORT  WriteString, WriteLn,...;

CONST ZERO     = 0;
TYPE StackRec  = POINTER TO Node;
     Node      = RECORD
       S       : ARRAY [I...MaxStackSize] OF INTEGER;
       Top     : [0...MaxStackSize];
     END;

PROCEDURE Init (VAR Stk:StackRec);
BEGIN
    Stk^.Top:=0;
END Init;
```

```
PROCEDURE Push (VAR Stk:StackRec; Item:INTEGER; VAR Ok:BOOLEAN);
BEGIN
    WITH Stk^ DO
    If Top=MaxStackSize THEN
    ...     ...     ...


END Push;

PROCEDURE Pop (VAR Stk:StackRec; VAR Item: INTEGER; VAR Ok: BOOLEAN);
BEGIN
    WITH Stk^ DO
    If Top=ZERO THEN

    ...     ...     ...


END Pop;

BEGIN
    WriteString ('The stack module has been linked successfully');
END Stack.
```

2. Concurrent Processes in MODULA-2

For use concurrent processes, MODULA-2 implementations provide the "Processes" module that implements processes and synchronization signals, This module offers facilities for concurrent processing at a high-level of abstraction; if the software is ported from a uni-processor to a multi-processor system, or vice versa, changes to the MODULA-2 software will not be required. This will also hold if the software is ported to an operating system with a different kernel but similar I/O devices.

The object code for MODULA-2 software can run on a machine that has resident an operating system kernel such as that of MSDOS, UNIX, or VMS. When the object code is run the resident operating system will create a process; the latter is a process at the operating system level and the only created and activated when MODULA-2 object code is executed. The support of multiple concurrent MODULA-2 processess (represented as COROUTINES) need not involve more than one genuine operating system process. (Incidentally, coroutines are sequential programs that are executed quasi-concurrently. The processor is switched from one coroutine to another by an explicit transfer statement. A coroutine is resumed at the point where it was suspended by its own last transfer statement). Given below, is the definition part of the "Processes" module. (This module is standard but can also be defined by user to implement scheduling algorithms tailored to the user's needs).

```
DEFINITION MODULE Processes;
  EXPORT QUALIFIED SIGNAL, StartProcess, SEND, WAIT, Awaited, Init;

  TYPE SIGNAL;

  PROCEDURE StartProcess (P:PROC; N:INTEGER; Priority: INTEGER);
(* creates and activates a process with program P and workspace of size N words. PROC is a standard type defined
as PROC = PROCEDURE *)

  PROCEDURE WAIT (VAR S: SIGNAL);
(* wait for some other process to SEND signal S *)

  PROCEDURE SEND (VAR S: SIGNAL);
(* one process WAITing for condition S is placed into the list of "ready" processes. The calling process will
relinquish the processor only if it has been using processor for at least Q time units (time quantum preemption) *)

  PROCEDURE AWAITED (VAR S: SIGNAL): BOOLEAN;
  (*returns "true" if at least one process is WAITing for S*)

  PROCEDURE WAIT (VAR S: SIGNAL);
(* initialization of the signal S *)
END Processes.
```

A process wil continue to run until either a WAIT statement is executed or the end of the procedure P has been reached. Processes synchronize via so-called "signals" where every signal denotes a certain condition. When a process executes a WAIT on a signal S it will be suspended and resumed only when some other process executes a SEND on S. In such a case, if there are many processes WAITing on signal S, at most one will be made "ready"; the process that executed the SEND statement will be preempted only if it has been executing for at least Q time units. Note that real-clock interrupts will not preempt an executing MODULA-2 process (coroutine), as at the level of operating system processes. Also, calls to SEND and WAIT may translate into coroutine transfers.

2.1. Programming of Real-Time Systems

The meaning of the term "real-time systems" has been very much abused. It is assumed here, that a real-time system consists of multiple input and output devices managed in an asynchronous fashion by a set of concurrent processes. Devices are assigned different hardware priorities depending on the urgency with which they need to be attended to by the processor. Finally, it is assumed that processes synchronize via the high-level primitives SEND and WAIT only; a running process will relinquish the processor when any one of the following event occurs:

1. It executes a call to WAIT
2. It terminates after executing the code of the procedure assigned to the process by the call to "StartProcess"
3. It executes a call to SEND after using the processor for at least Q time units (the value of Q may very between systems).

During the design stage, a real-time system is broken up into a number of concurrent processes. Under MODULA-2, these processes can be created and activated by placing their main code in parameterless procedure and issuing the call to "StartProcess".

2.1.1. Process Synchronization Modules

The designer could choose to place the main code of processes in separate modules. Within the main code, a real-time process will have to wait (remain in a suspend state) until some EVENT is triggered, possibly by another active process; events are used for synchronization purposes between processes where no actual information transfer is needed. A destination process may wait for an event occurence, and a source task may signal an event that activates the destination process. For this reason, modules with the main code are referred to as proccess synchronization modules (PSM).

Under MODULA-2, a PSM will have the following structure:

```
LOOP
WAIT (event); (★ "event" is of type SIGNAL ★)
IF eventl THEN
    event 1 triggered - process it
ELSE IF Event 2 THEN
    event 2 triggerred - process it
ELSE
    event N triggered - process it
ENDIF
ENDLOOP
```

Information concerning the exact nature of triggered events can be placed in an area known to both the source and destination processes. Such areas are commonly referred to as PORTS. A source process wishing to signal the occurence of an event to the (destination) process above, will first place event information in the port concerned. The source process will then execute a SEND on the signal variable "event". After it is reactivated, the destination process will proceed to find out what event was triggerred and process it. The ports and the event synchronization signal variable can be declared in, and exported by, the PSM of the destination process. Source processes that trigger the events can import these variables. The definition module below, is of a PSM for a process that can be triggered by the occurence of two events.

```
DEFINITION MODULE PSMn;
  FROM Processes IMPORT SIGNAL;
  FROM SYSTEM IMPORT ADDRESS;
  EXPORT QUALIFIED PSMn-PORT1, PSMn-PORT2, PSMn-EVENT;
VAR PSMn-EVENT:SIGNAL;                (★ event-occurence signal ★ )
     PSMn-PORTI : RECORD
        Occured : BOOLEAN;            (★ TRUE if triggered ★ )
        DATA : CHAR;                  (★ actual port contents ★ )
     END;
```

```
PSMn-PORT2 : RECORD

    Occured : BOOLEAN;
    Data : RECORD
       BLen : CARDINAL;            (★ length of block in number of words ★ )
       Blk : ADDRESS;              (★ pointer to first word in block ★ )

    END
END TSMn.
```

2.1.2. Message Communication Modules

It is sometimes necessary for real-time processes to exchange data in the form of messages. For example, in a robot controller system, we might have among many others, the following two processes:

1. INTERPRETER - interprets selected programs which may instruct the sending of motion blocks to the axis manager.
2. AXIS MANAGER - takes motion blocks as input, translate it into device specific axis blocks, sends it to an axis controller and then waits for an acknowledgement.

Massage Communications Modules (MCM) handle message communication consisting of either loosely coupled messages that are buffered between processes, or closely coupled communication where the producer process sends a message and then waits for a 'reply'. A typical MCM has procedures for getting an available (message) block, entering data in the block, sending the block, receiving the block, extracting data from the block. Normally, two processes use the MCM for communication; the one process is called the producer and the other the consumer. MCMs export a data type in opaque mode and also export its associated operations. Thus, the details of the data type's structure and of the operations are hidden from importing modules. Variables of the opaque type are declared in the importing modules.

```
DEFINITION MODULE SampleMCM;
 EXPORT QUALIFIED Getblock, SendBlock, RecvBlock, FetchDatum,
 DepositDatum, InitBlock, BlockIsAvailable, BlocksInterface;

 TYPE BlocksInterface;

 PROCEDURE GetBlock (VAR B: BlocksInterface; Size: CARDINAL);
(★  allocates a memory block of 'SIZE' words★ )
 PROCEDURE SendBlock (VAR B: BlocksInterface);

(★  called by producer to add to the queue of blocks for interface "B" a block that has been filled with data. It calls
    SEND to signal the consumer process in case where the latter is waiting for a block ★ )

 PROCEDURE BlockIsAvailable (B: BlocksInterface): BOOLEAN;
(★  returns TRUE only if there is at least one block ready for consumption ★ )

 PROCEDURE RecvBlock (VAR B: BlocksInterface);
(★  called by consumer process to get the next block that is available for consumption. If no block is available a call to
    WAIT will be made ★ )

 PROCEDURE FetchDatum (VAR B: BlocksInterface; VAR Datum: CHAR; VAR EOD:BOOLEAN);

(★  extracts and returns the next character from block being emptied by the consumer; if the character extracted is
    the last one in the block, EOD will be set to true and the storage occupied by the block deallocated i.e. returned to
    the pool of available storage ★ )
 PROCEDURE DepositDatum (VAR B: BlocksInterface; Datum: CHAR);
(★  called by the producer to deposit a character in the next available position inside the block obtained by the last
    call to "GetBlock" ★ )

 PROCEDURE InitBlock (VAR B: BlocksInterface);
(★  compulsory initialization ★ )
END SampleMCM.
```

Loosely coupled processes will require to make use of the above module. However, each pair will have to make use of a common "BlocksInterface". As each TSM is implemented in a separate module, the common "BlocksInterface" will be declared in a well known definition module from which producer and consumer processes can import them from inside their main TSM.

3. Device-Handling

3.1. Asynchronous Operation of I/O Devices

Software for device management consists of two basic routines: the FEEDER and DRIVER. The feeder is a routine which is called by a user process each time it wishes to have an I/O request performed. In the case of a block device, such a request must specify the number of words to be transferred, the direction of the transfer (read or write), and the addresses in memory and on the device. If the device is a character device the request specifies only the character to be output. The feeder inserts a new request into a list of request that have been issued but not yet serviced.

The driver routine is invoked by hardware following an interrupt from the device. The address of the driver routine is stored in a special location known as the INTERRUPT VECTOR. If the list of requests contains additional entries, the driver selects the next one and initiates its service.

The devices in a real-time system are generally assigned a priority dependent upon the urgency with they are serviced. A system in which an interrupt from a low-priority device can interrupt, and therefore delay the servicing of a high-priority device does not make sense. On the other hand, by disabling interrupts completely in the driver and feeder routines of a low priority device would delay response to a high-priority interrupt. Such considerations are of great importance in real-time systems where the effectiveness of a system is measured by the maximum time in takes from the occurence of a certain event to invocation of the appropriate driver. Clearly, if interrupts are disabled the system will not immediately detect the occurence of the event.

No doubt, where differences between priorities are important, a priority interrupt structure is needed. Machines have a special register, called the mask register, for selectively disabling interrupts from particular devices; instructions are provided for the reading and writing of this register. In this way, it is possible for the driver of a particular device to be interrupted only by devices with a higher priority.

3.2. Device Management with MODULA-2

MODULA—2 provides for the direct manipulation of device registers that in most processors (PDP-II, MC68000) appear as if they were memory variables at fixed addresses. For example, in the PDP-II, the keyboard control status word CSQ, is represented by the octal address 777560, and the buffer device register represented by the octal address 777562.

```
VAR
    CSW [777560] : BITSET;
    Data [777562B] : CHAR;
```

The standard BITSET type is defined as:

```
    BITSET = SET OF [0..W—1];
```

where W is the wordlength of the computer used. Keyboard interrupts can be enabled by resetting bit 7 of the control status word.

EXCL (CSW, 6) which is equivalent to CSW : = CSW - {6}

MODULA-2 allows for the operation of I/O devices in genuine concurrency with internal MODULA—2 processes. A device driver is implemented as a coroutine and MODULA-2 programs consider interrupts as an unscheduled coroutine transfer to this (driver) coroutine/process. Given below, is sample software for management of an input character device on the PDP-II.

```
DEFINITION MODULE CharDevice;
  EXPORT QUALIFIED GET, NDeposited;
  PROCEDURE GET (VAR Ch: CHAR);
  VAR NDeposited: CARDINAL; (* read-only * )
END CharDevice;
```

```
IMPLEMENTATION MODULE CharDevice [3] ; (★ module priority level is 3 ★ )
  FROM SYSTEM IMPORT PROCESS, NEWSPPROCESS, TRANSFER, IOTRANSFER, ADR, SIZE, WORD;

  CONST BUFFSIZE =100;
VAR    Data [777652B] : CHAR. (★ device character buffer ★ )
       CSW [777650B] : BITSET; (★ control status word ★ )
       In, Out: [0..BUFFSIZE—I] OF CHAR;
       WSP: ARRAY [1..150] OF WORD; (★ workspace of driver process ★ )
       Driver, InterProcess : PROCESS; (★ pointers to processes ★ )

PROCEDURE GET (VAR Ch: CHAR) (★ feeder routine ★ )
BEGIN
     IF NDeposited > 0 THEN
          Ch: = Buffer [out];
          Out : = (Out+1) MOD BUFFSIZE;
          NDeposited:=NDeposited-1;
     END;
END GET;

PROCEDURE Producer; (★ driver acting as a coroutine ★ )
BEGIN
     EXCL (CSW, 6); (★ enable interrupts from this device ★ )
     LOOP
            IOTRANSFER (Driver, InterProcess, 60B);
            IF NDeposited <BUFFSIZE THEN (★ ignore when buffer is full ★ )
               NBuffer [In] : =Data;
               NIn :=(In+1) MOD BUFFSIZE;
               NDeposited:=NDeposited +1
            END;
     END
END Producer;

BEGIN
     NDeposited:=O; In:=0; Out:=0;
(★  create a process to execute the code of procedure "Producer" and assign this process/coroutine to variable
    "Driver" ★ )
          NEWSPROCESS (Producer, ADR(WSP), SIZE(WSP), Driver);
(★  assign running process to "InterProcess", start running "Driver" ★ )
          TRANSFER (InterProcess, Driver);
END CharDevice.
```

The procedure call

IOTRANSFER (Driver, InterProcess, 60B)

suspends the calling device coroutine, assigns it to "Driver", resumes the suspended process "InterProcess". The latter now executes concurrently with the device. When the device completes its operation it files an interrupt to the processor. When the processor is ready to process the interrupt, it resumes the device process "Driver", and assigns the interrupted process to "InterProcess". The above then repeats all over again due to presence of the LOOP repetition structure. The third parameter, 60B, is the interrupt vector assigned to the device.

As already pointed out, in the context of real-time systems, a priority interrupt structure is necessary. In MODULA-2 modules may be given a certain priority level (3 in the module above) and every device given a hardware priority level. A program can be interrupted, if and only if the interrupting device has a hardware priority higher than the priority of the module that is currently being executed.

REFERENCES:

1) Nicklaus Wirth. Programmin in MODULA—2, Springer-Verlag, 1983.
2) C. Ghezzi & M. Jazayeri. Programming Language Concepts, Wiley, 1982.
3) Hassan Gomea. Software Development of Real-Time Systems, Communications of the ACM, July 1986.

MICROCOMPUTER TECHNOLOGY TRENDS

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1. INTRODUCTION

The evolution of electronic technology over the past decade has been so rapid that it is sometimes called a revolution. Is this large claim justified? I believe the answer is yes. It is true that what we have seen, to some extent, is a steady quantitive evolution: decreasing in size electronic components performing increasingly complex electronic functions at ever higher speeds and at ever lower cost.

It is not a exaggeration to say that most of the technological achievements of the past decade are based on microelectronics. Mircoelectronic devices are the soul of new products ranging from handheld calculators and digital watches to communication satellites.

Somewhat subtler, but eventually more significant, is the effect of microelectronics on the computer. The capacity of the computer for storing, processing and displaying information has been greatly enchanced.

The purpose of this document is to highlight Technology, Design and Marketing trends towards these enchancements, in key product areas such as Microprocessors, Memories, Displays, Mass storage sybsystems and Printers.

2. Microprocessors (Microcomputer systems)

Is the micro replacing the mini and the mainframe? Maybe. Who is winning the bit war?

Intel led the market with the introduction of the first 8 - bit microprocessor, and along with it, the birth of the "microcomputer". Soon after, Zilog came along with the Z80, 8-bit microprocessor, legitimizing the use of micros for data and word processing applications. Aided by the popularity of the CPM operating system, won the 8-bit war.

The Z80, CPM and floppy based system has until recently been the most widely available system.

Further to establishing the foundation of the 8-bit microprocessor industry, Intel announced its 16-bit microprocessor addressing all of the shortcomings of the 8-bit systems. However, very quickly Intel realized that the industry invested some seven years in the development of peripherals to go with the 8-bit and there was none of that to go with the 16-bit.

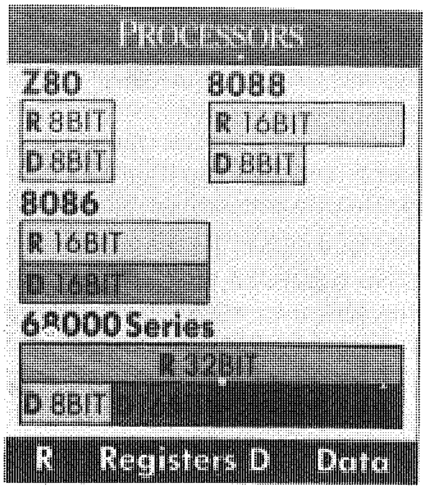
With no hesitation Intel announced a revolutionary new architecture combining the 16-bit internal architecture with the 8-bit input/output capability.

This new architecture of the Intel's 8088, along with all its technical and economic advantages backed by IBM, become the "Industry Standard" for personal professional computer and for high performance small data processing system.

Motorola, a major chip designer and manufacturer has trailed behind Intel's and Zilog's successes in the 8-bit market. Motorola's 68000 entry, a truly 32-bit micro has shaken the market. However, it is too early to identify a winner in the 16/32 bit fray. In conclusion the industry is gravitating towards two type of systems:

(i) The professional "intelligent" workstation, and

(ii) The general purpose high performance distributed/transaction processing workstation.



2.1 The professional workstation

Intelligent workstations or Personal computers (PCs) they have one goal. To offer the maximum performance and functionality for the least cost. Workstations utilizing processors like the intel 80188/80286, 8/16 bit wide memory and the IBM PC general architecture can reach above goal.

Further with improved bandwidth architecture, (response times for screen input/output), graphics, colour graphics and image processing are possible. Capabilities such as memory cache, memory management, coprocessing, gateway communication and also the ability to run more than one operating system using the same hardware, MS-DOS CPM-86, UNIX etc. gives the picture of the professional workstation.

2.2 High performance distributed/transaction processing workstation

There are basically two types of systems in this category: Distributed data processing and transaction processing. Distributed data processing is where application programs reside at the network-global level rather than at the node level with all programs and files referenced across the entire network.

Transaction processing is where multi-processing, multitasking, multi-threading operations are needed.

For both the above, utilization of 32 bit micros and 32 bit wide memory will compete with and surpass the performance of mini and mainframe of today. Innovations in both distributed workstations and transaction processing will further blur this distrinction as industry announces products based on the Intel iAPX 386/432, National Semiconductor 160000, Zilog 80000 and more of 68000.

3. Memories

Memory technology has also seen a similar rapid development with comparable improvements in cost per performance ratios. With the introduction of semiconductor memories early in 1970s, memory capacity per chip has followed an exponential improvement in packing density, roughly increasing four-fold every three years.

The 256 K-bit DRAM (Dynamic random access memory) chip took over from the "traditional" 64K-bit DRAM, and 1M-bit DRAM is following the same trend.

Computer manufactures are able with the reduction of price per K-bit to supply two to ten times as much memory to customers for the same price.

4. Displays

Large scale integration (LSI) has revolutionized the "display" or "monitor" market. The latest round of LSI and VLSI devices offer additional features, increasing product performance at a relatively low cost.

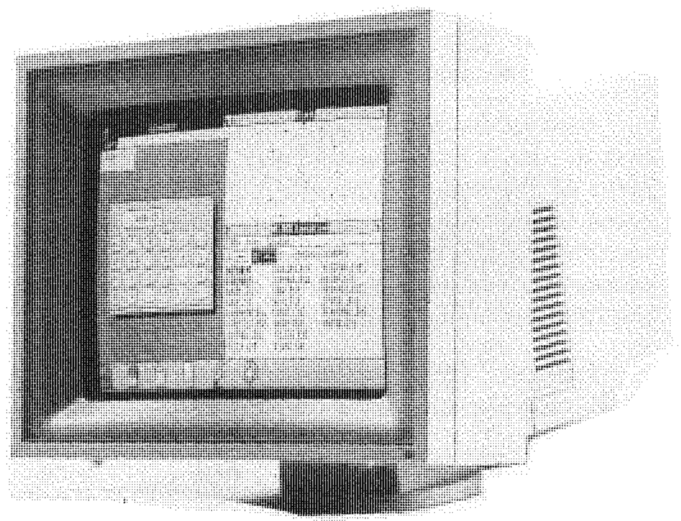
Another factor considered by manufactures is that, displays provide a human interface to machines and therefore they paved the way for the recognition of "ergonomics". Popular ergonomic features now included are:

- Adjustable console (swivelling and tilting)
- High resolution character formats
- Non glare sceen with dark characters and ligh background, and
- Touch screen facility.

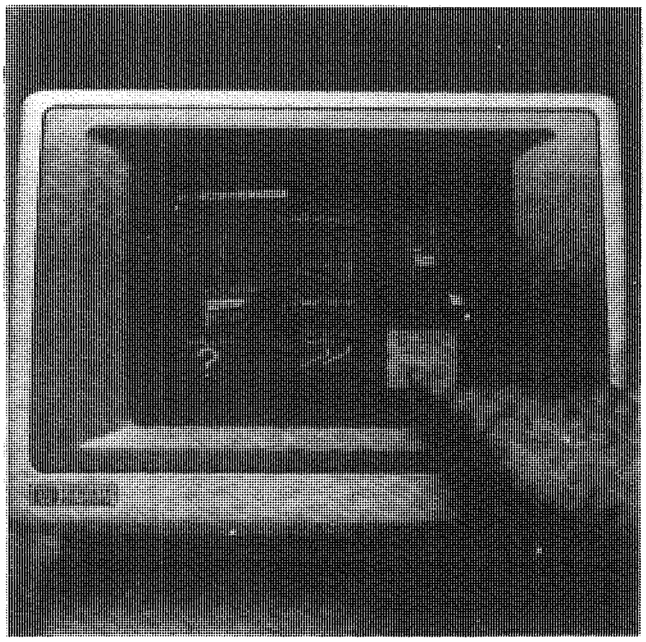
Displays can be classified into two categories: CRT (Cathode - Ray Tube) and LCD'S (Liquid Crystal Displays). CRT being the most popular up to now offering options of high resolution monochrome 800X400 pixels on text or graphics mode and medium to high resolution colour monitors 640X350 pixels giving up to 64 colours.

LCDS offering lower power consumption and more practical for portability come to the computer arena five years ago. Applications were limited due to the limitation of hard to read them, now this limitation is completely cured, and the latest "supertwist" and "backlit" LCDS offering 640X200 pixels resolution, quality comparable with conventional CRT monitors. Price/performance is no longer as important issue as quality and reliability.

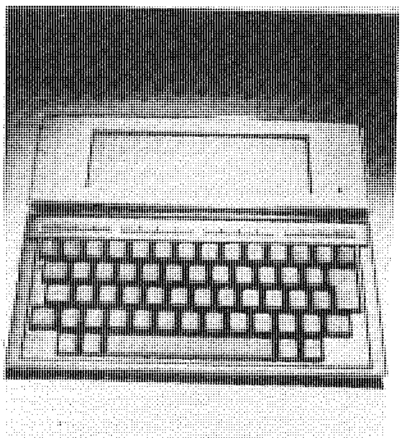
The display market has become a commodity driven one with trends such as offshore manufacturing, customize chip designs, LCDS sophisticated designs and digital desplays. Prices will erode further at the same time while prices drop further additional functionality will be available.



Monochrome ergonomic monitor



Touch screen facility monitor



LCD screen microcomputer

5. Mass storage sub-systems

The other memory technology that has significantly influenced computer development and application is that of the magnetic disc. Data recorded magnetically on a rapidly rotating disc has seen a similar exponential increase in density and reduction in price as chip memories, i.e. Disk diameter has reduced in size from 14´´ - 8´´ - 5 1/4 - 3´´.

Three important trends in mass storage systems will be covered.

(i) The widely accepted 5 1/4 ´´ form factor disk
(ii) Thin film technology
(iii) The 3 ´´ micro floppy.

5.1. 5 1/4 floppy, Winchester and tape catridge drives

This market has been a very price sensitive one. Unit prices continue their downward trend and while performance measured in storage capacity, access time, transfer rate and reliability consistently improves. Some of the common features found in 5 1/4 ´´ systems are:

— Up to 3.2. M-bytes for double sided/double density floppy

— Greater than 100 M-bytes capacity for Winchester disks

— Up to 22 M-bytes for removable Winchester disks

— 5 1/4 ´´ half-heigh (floppy & winchester) proved to be the most popular

— Double sided dual head problems has been eliminated through design improvements

— Disk and tape controllers has been adopted as standard

— VLSI technology enables controllers to handle both floppies and winchesters.

5.2 Thin film technology

The utilization of thin film technology, for both media and read/write heads enable manufactures of winchester drives to increase capacity and yet keep prices down.

Thin film technology is also used in conjuction with vertical recording doubling capacity yet again.

Vertical recording is a technique where data is stored perpendicularly to the plane of the media. While thin-film technology is making inroads in winchester products and promises potential in other areas, magnetooptics, used in Laser-based disk is taking the lead. Read only Magneto-optic disks (the size of a credit card) of 10 M-bytes and 2 M-bytes are currently available.

5.3 The 3´´ Microfloppy

Another important development is the entry of the 3 ´´ microfloppy. With the utilization fo VLSI and PAL (Programmable Array Logic) technology the density of the disk is increased by constrantly changing the rotational speed of the disk, 800 K-byte 3 1/4 ´´ microfloppies are now available. Subject to its size, high density and price reduction is trend to become the new "industry standard" for PCs.

6. Printers

With the boom in personal computers, printer ventors has introduced several type of printers, such as: Dot-matrix, Daisywheel, Thermal (silentype) ink jet, Laser, etc. The increased capabilities and functionality of impact and a non impact printers are further discussed.

6.1. Impact Printers

Dot-matrix printers are poised to compete with daisywheels and they have enter the letter quality arena (word processing) and even with pen plotters in the colour graphics arena.

Compact dot-matrix printers have 9 pin printheads with speeds up to 250 cps (characters per second) and more heavy duty dot-matrix printers have 18-24 pin printheads and speeds up to 600 cps. Major dot-matrix features and improvements have been made in the following areas:

(a) Colour and graphics capabilities giving them flexibilities that daisy wheels don't have.

(b) Printer intelligence and versatility. Selectable/ programmable: font and font size, speed, margins and leading edge

(c) Autopaper loading, allowing the use of ordinary paper

(d) Ergonomics: Lower noise (below 50dB), size of footprint

(e) Ease of handling and maintenance.

High density dot products have reached near letter quality output. For the small system the dot-matrix provides a single printer that handles both 'word' and 'data' processing tasks.

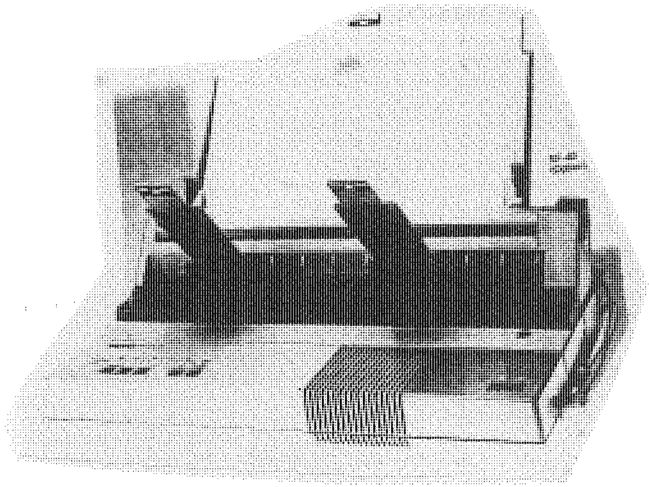
The extend of the market demand for such a dual purpose printer it opens the horizons for ventors to introduce the Twinriter which is a combination of both daisywheel and dot-matrix into a single unit.

6.2 Non-impact printers

Non impact printing technologies have come along way during the last five years. Product improvements and price reduction are with us and further improvements and price reduction is expected by the end of next year.

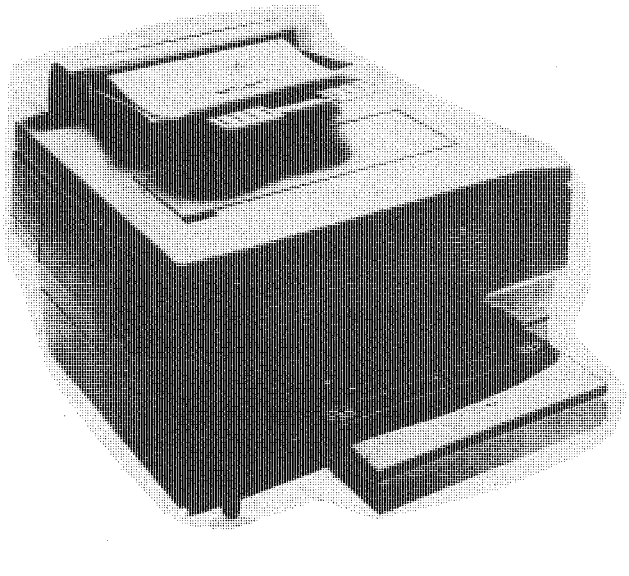
6.2.1 Thermal printers

With the introduction of many intelligent terminals in the office, a need is realized by printer ventors to manufacture a silent printer having the speed of the dot-matrix and quality of the daisywheel. The answer was the introduction of the thermal printing head using either a special ink ribbon or thermal sensitive paper. Set back due to high price of thermal paper and ribbons, now is overcome and is gathering momentum.



Impact Dot-matrix printer

Non-impact brother thermal printer



Non-impact Laser printer.

6.2.2 Laser printers

Laser printers previously realized were very costly, and design for utilization with large-scale computers which attain very high data processing speeds. Therefore, other important features of Laser printers such as excellent printing clarity, low audible noise, multifunctions, printing on plain paper, etc., have not been well taken advantage of by general users.

With the introduction of VLSI technology and reduction of hardware cost, Laser printer technology will play a very important role as a data output method in the office of the present and the future.

The Laser printer is often called a page printer and in fact that is how is printing; pages. Its speed is expressed in terms of pages per minute.

The Laser printer, creates images by scanning its Laser beam across a charged photographic drum, the beam selectively charges areas on the drum. Toner or ink with the opposite charge adheres to the photoconductor and its transferred to paper by heat and pressure.

Currently-ventors are offering compact laser printers with characteristics such as:

(a) Ten pages per minute (10 ppm)

(b) 300 dots per inch resolution

(c) Full international character set

(d) A range of 36 standard fonts, store in its 1M-byte memory (ROM)

(e) 1M-byte for processing (RAM)

(f) 38 kinds of bar-code are also supplied as standard for print and automatically read by bar-code readers.

Laser printers are looked set to take over from mechanical printers in tomorrow's office as demand for business graphics increased. The problem is that, fast laser printers are still very expensive.

As alternative ventors are introducing LCS (Liquid Crystal Shutter) or LED (Light Emitting Diodes) printers, equivalent to laser printers. Though resolution is lower present a significant challenge to laser printers.

References:

Electronics and Power — I.E.E. Journal
The micro electronics Revolution — Tom Forester
Micro decision — Magazine
I.E.E. news — I.E.E. paper
Personal computing Today — Magazine

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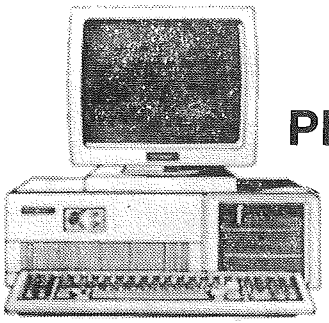

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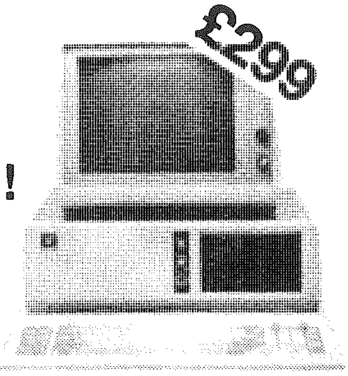

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PROGRAMMABLE CONTROLLERS

by E. Michael BSc, MSc, Lecturer HTI

INTRODUCTION

A programmable Controller is a digitally operated electronic device which uses a programmable memory for the internal storage of instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control through digital or analog input/output modules various types of machines or processes. This is the difinition provided by the NEMA standards which clearly describes the Programmable Controller characteristics both as far as the input and the output signals are concerned as well as its function.

A programmable Controller is thus fundamentally a digital computer which has been specifically designed to work in the industrial environment for process control through easily developed software programmes. As such it enables the optimisation and easy modification of process control circuits which otherwise are very time consuming or even unrealistic for implementation.

1. Construction-Operation

The Programmable Controllers consist of the following elements:

(a) Central Processing Unit (CPU) or Processor

(b) Memory

(c) Programming device

(d) Power Supply

(e) Input/Output interfaces or modules.

The first four parts are common for every digital computer which justifies the statement that this device is fundamentally a specialised computer.

The Input/Output modules enable the interfacing of the Processor with the industrial world and translate those signals into realisable form for the CPU. Usually they consist of individual blocks with a capacity of upto 16 Input/Output which can accept the following signals:-

(a) AC Voltage, various levels

(b) DC Voltage

(c) BCD (Binary-Coded Decimal) inputs and outputs

(d) Pulse data

(e) Low-level analog signals such as thermocouple millivolt signals.

The Input/Output modules are so construted as to provide protection against every possible effect of the industrial environment on the signal they carry and also on the Programmable Controller.

The CPU executes the various logic functions required by the programme in relation to the various inputs and accordingly determines the appropriate outputs through mathematical comparisons or logic functions.

The Memory stores the programme which specifies the logic functions to be performed. Memory capacities range from 1K up to 48K and even more.

The programme is loaded into the memory by means of a programming device which can be a computer keyboard with screen or through a small manual keyboard device.

The Power Supply provides the necessary power to drive the processor and energise the output signals. It is also protecting the controller against noise of the electrical supply.

2. Implementation

In order to appreciate the capabilities of a Programmable Controller it is necessary to recall the problems encountered with the standard "Hard-wired" control circuits through which process control is realised in industry. These circuits are designed to implement the sequence control for a certain process by using electromechanical devices such as relays, timers, steppers, counters etc. They start with the description of a control sequence which is converted to a ladder diagram and the design engineer links together the individual components to form the control system. The circuit is then wired on a control panel near the machine and the necessary interconnections with the operator panel and the machine input/output signals are wired. Any errors then in the control circuit or additions or modifications require extra control devices and the difficult task of mounting and wiring them on the existing circuit. Furthermore the detection of any defects in such circuit is a time consuming task which often results in significant loss of production.

Using a Programmable Controller for process control circuits greatly simplifies their implementation, modification and their maintenance because the circuit is simulating through highspeed electronics the same functions that previously required individual electromechanical components. The Programmable Controller uses the same ladder diagram as used for the electromechanical relay systems as its programming language. This eases very much its programming and makes it friendly to the operators and the technicians involved who are familiar with the standard control circuits. In addition it provides a great number of software timers, up or down counters logic functions comparators, drum controllers and registers.

The modifications now on the circuit are very easily implemented by simply changing the programme in the memory of the Programmable Controller. Furthermore error detection can be performed on the screen of the programming terminal which shows the active and inactive input/outputs and thus enables the identification of the contact of the circuit which does not follow the control logic.

3. Programming Languages

As it has been mentioned previously the Programmable Controller must be programmed in order to implement the sequence of steps required for the process control. For this purpose the following languages are available:-

(a) **Ladder diagram.** This language simulates the actual relay diagram with available elements such as normally open or closed contacts, timers, counters, drum controllers, coils etc., The programmer recalls the appropriate control element and specifies it in a very similar way as for the "hard wired" control circuit. The screen of the monitor provides a visual display of the circuit on which modifications or corrections can be very easily introduced at any stage of the design or the construction of the process control circuit.

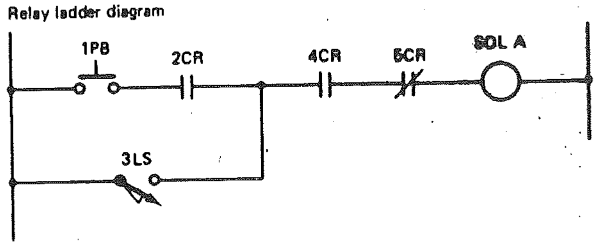
(b) **Boolean-based languages.** The logic statements of Boolean algebra are used to establish the relationship between the inputs and the outputs and to energise the appropriate output element. Programming with this language is not easy and modifications are difficult.

(c) **Mnemonic languages.** It is similar to computer assembly language and includes statements such as LOAD, AND, OR and STORE.

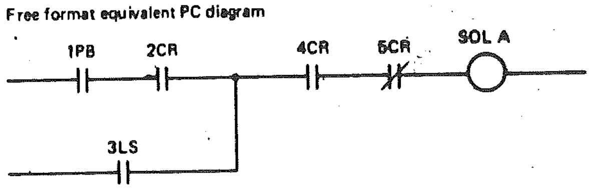
The last two languages require skilled personnel to be applied and are considered difficult for the plant personnel who often are unfamiliar with programming.

Typical examples of programmes using the above methods to implement a simple control circuit are shown in Figure 1. It is clearly evident the similarity of the Ladder diagram with the existing standard diagrams used to describe the same circuit.

Relay ladder diagram



Free format equivalent PC diagram



Boolean statement

$((1PB \cdot 2CR) + 3LS) \cdot 4CR \cdot \overline{5CR} = SOL\ A$

Code or mnemonic language

LOAD	1PB
AND	2CR
OR	3LS
AND	4CR
CAND	5CR
STORE	SOL A

Figure 1. Three basic types of PC programming languages. (Reprinted from CAD:CAM [1].)

4. Functions Available and Capabilities of the P.C.

The Programmable Controller through its memory and its programme provides all the functions of the electromechanical control circuits with software implementation and makes them programmable. The functions available from a Programmable Controller can be listed as follows:

(a) Detection of the state of all the input/output ports and energisation of the appropriate outputs. Once a port is detected it can be called several times by the programme without further wiring requirements. Furthermore internal bits are available which are energised by the programme and are called at another stage without any wiring needed. Remote Input/Outputs can be detected and their state supplied to the controller through the available serial communication port.

(b) Generation of programmable timing functions as internal signals without the use of electromechanical timers. A very wide range of timers can be programmed and used to improve the process control for high production efficiency and even for energy management.

(c) Counting and Arithmetic functions. These are programmed to increment or decrement their content when a contact has closed or used to do arithmetic functions for certain signals and give the appropriate output.

(d) Drum Controllers. Simulate a drum with a number of outputs which change in each step and can be used to control complex processes which follow a cyclic form.

(e) Comparator functions. Provide the facility of comparison between two signals such as GREATER, EQUAL and LESS and energise accordingly other signals.

(f) Analoque signals. Such inputs can be processed by some types of Programmable Controllers and can be used to provide Proportional Integral or Derivative control of processes.

(g) Compute and Transfer function. Most advanced Programmable Controllers are provided with the facility to exchange information with other controllers or with centralised computer systems. This makes them as the executing part of the totally automated production system.

5. Applications

The Programmable Controllers are used in cases where the machine to be controlled has many limit or control switches which often require recombination when a different product is involved. Such applications are observed in a variety of industrial establishments as in transfer machines, flow line, conveyor systems, injection moulding, grinding, welding, cement processing, food processing, energy management, production testing equipment, water pumping stations, robot control etc.,

Utilising the characteristics of the Programmable Controller the various sections of the production line can be synchronised with the aim of production optimisation and efficient use of energy and materials.

6. Conclusion

The Programmable Controller being a software based equivalent of a relay panel is a general purpose device which can be programmed to control a variety of machines and programmes can be changed easily for new jobs or changes in production routines. Its ability to communicate with other similar devices and exchange information formulates the basis of a fully automated production line. It brings therefore the advantages of high technology in the industrial environment and its applications are increasing rapidly.

7. References.

1. CAD/CAM: Computer Aided Design and Manufacturing Mikell P. Groover, Emory W. Zimmers, JR., Prentice/Hall I International
2. Telemechanique TSX47 Programmable Controller Manual
3. Allen Bradley Product data bulletin 2700
4. "Controller Systems" PO 105-107 Machine Designs, May 1986

THE MINIMAL NOISE CONCEPT AND ITS APPLICATION

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Summary

One may define a certain amount of noise which is inherent in the fundamental work process and should be called «Minimum Noise». Single rotor axial flow fan's unavoidable noise source is the vortex shedding in the wake. Machines, using, impact processes, to reshape workpieces, will show the so called acceleration noise of the hammer as unavoidable noise source.

Introduction

With the world wide introduction of limits on the noise in factories, entertaining centers and homes, purchasers of any noise producing machine demand less emission. It is frequenlty due to the customer's ignorance in acoustics that impossible requirements are set and ignorance on the manufacture's side to accept some. It happens very rarely that scientifically correct measurement justifies subjective judgement, hence commercial life relies on adjectives like: noiseless, quiet etc. No wonder that not long ago a European country in which such adjectives meant, - due to legislation -a certain sound pressure level in well defined acoustical environment, checked the vacuum-cleaners on sale and found that 72% of them did not fulfil the relevant requirement. The blame is always put by both sides on the machine designer. However, unless acousticians provide a proof of feasibility of the required rate of noiselessness, all parties involved will continue to ignore limits or will not rack their brains to evade the use of the particular machine by changing technology, for instance.

The concept

Noise is not a veritable disaster and in most cases can be avoided to a certain limit by skilful design. It is therefore always important to know how much noise arises from design faults of material and economic limitations, not related directly to work process.

On the other hand one may define a certain amount of noise which is inherent in the fudamental work process and should be therefore called: «Minimum Noise». The minimum noise is then the lowest level of radiated acoustic energy which is unavoidable if the requirements fixed for the desiger are set. Once the minimum noise of a machine has been worked out, different designs can be evaluated on the basis of the actual noise emitted as compared to the calculated minimum one.

The next problem is the form in which the minimum noise should be rated. Some countries consider the peak acoustic pressure, hence the maximum level as the reference value, others insist on a daily dose of A-weighted noise energy. No other way seems to lead out of this dilemma as the way of considering always the relevant or legal limit as reference.

The minimum noise of axial flow fans

Axial flow fans used in airconditioning, ventilating or cooling systems are judged partly by their disturbing noise.

The usually continuous spectrum within certain cases dominating pure tone peaks are due to aerodynamically generated noise, radiated by several kinds of sources as follows:

Pre-and post-rotators serve to increase the static pressure rise of the axial flow fan. Let us assume that they are not required - as it is by many commercial low pressure fans - hence the so called potential and wake interaction noise does not enter into the picture. The sigle rotor may be still influenced by flow disturbances of struts supporting the center body of the machine. If, by a special construction struts also may be avoided (Fig. 1), only the turbulence remains as a sound source at the inlet.

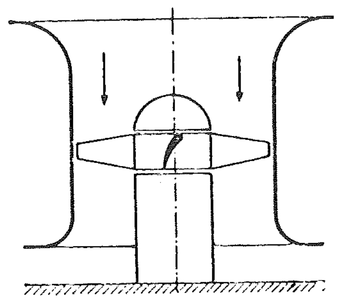

Fig 1:

Concerning the rotor, three sources should be examined. One of the three, the rotational noise -investigated by Gutin [1] - is considered as an impulse caused by blade thickness and the blade lift, assumed being constant to an observer moving with the blade. However, since axial flow fans working in airconditioning systems run usually with a tip speed of u < 80 m/s, far from the velocity of sound, the local hydraulic short-circuiting in the near field is strong, hence the radiation efficiency of this kind of sound source is very low. Calculations showed and experiments proved that its contribution to fan-noise can be neglected.

Oncoming turbulence may cause unsteady lift forces which in turn produce broad band noise. To avoide it, a bell-shaped inlet should stretch the turbulent eddies decreasing so the tangential intensity considerably and the axial one slightly. Even the thin boundary layer will not represent a dominant sound source.

Investigations have shown that the discrete frequency noise of a single rotor can be reduced to a level insignificant relative to the broadband vortex-shedding noise level from the rotor blades [2].

The so called vortex-shedding is due to the different flow velocity, leaving the trailing edge from the upper and lower side of the profile. The eddy wake caused by the velocity gradient generates in turn circulation, hence pressure fluctuation on the blade. The wake field, represented by an acoustic quadrupole field, hence triggers off a dipole source on the solid surface of the blade.

It may be noted here that the broad band vortex-shedding noise level can be predicted and has been proved by expreriments as well [3].

Technically it is possible to design an axial flow fan which produces only a broad-band vortex-shedding noise which, as indicated, originates from the unavoidable wake caused by the velocity difference between the upper and lower surface of the blade. The difference however produces the lift and thus the pressure rise across the blade row which in turn is the goal for operating a fan. It may be certainly posible to remove the blade wakes by suction or blowing the trailing edges, however the price and the reliability of such a construction is a present questionable.

We have reached the point where - excluding the possibility of wake manipulation - the source, from where the unavoidable noise will be radiated, has been found. This noise therefore can be considered for most of the commercial fans as minimum noise.

It was possible to build up a simple formula -based on fundamental aeroacoustic findings [3], [4], [5] — offerning minimum sound power levels for the above mentioned «rotor only» axial flow fans [6], [7].

$$L_{w\,min} = 27 + 10\ \lg \dot{V} + 23 \lg \Delta p_t \qquad [\mathrm{dB}]$$

where $\dot{V}$ [m^3/s] is the flow rate and Δp_t. [Pa] the total head rise.

Concerning the emitted sound power level of an axial flow fan the widely used empirical formula is as follows:

$$L_w = 40 + 10\ 1g \dot{V} + 20 \lg \Delta p_t \qquad [\mathrm{dB}]$$

in which the constant may vary ±4 dB according to experience. Taking the minimum 40—4=36 compared to 27 seems to be quite a considerable difference. However, it should be noted that the multiplier of Δp_t is 23 instead of 20. This will compensate the 9 dB difference in the constants since e.g. taking Δp_t=500 Pa - a very common case - would immediately mean 3 lg 500=8.1 dB.

Impact processes

Apart form aerodynamically generated machine noise, machines in the field of production are -generally speaking - reshaping the workpiece and usually built up over several hundreds of milliseconds and released for the process in microseconds.

The energy available is usually far more than the process needs, hence the excess is transformed into vibration. Vibrational energy finding a good radiator on any part of the machine will then be changed into radiative energy called noise.

Impact processes are numerous. Forging, riveting, sawing, planing, textile operations but also reciprocating engines, pneumatic drills or even the backlash in different mechanisms represent impact processes.

The noise generated arises from several sources. The hammer, anvil, punch, saw tooth etc. accelerates and decelerates on impact causing pressure perturbations, radiating pulse like sound, called acceleration noise. Immediately after the impact the workpiece changes shape as well, causing again a pressure perturbation, the so called billet noise. It is then followed by the vibrational noise from the workpiece due to the excess energy not absorbed by the material forming process. Some of this energy flows into the supporting structure and to the floor which then radiates sound, called ringing noise.

Having described the sound sources, let us see which of them can be - even if only theoretically -avoided. It seems that if there is no excess energy, no vibration will start, hence the so called ringing noise can be avoided. Practically it shows that not only the minimizing of the excess energy, but its absorbtion or prevention of its radiation is the main job of the designer.

There is however the acceleration noise which, if any solid body is accelerated or decelerated, will be more or less generated. It is a physical fact, hence it cannot be avoided. If so, we have reached the cause of the minimum noise, and it would be advantageous to know how strong does it depend on the various factors.

Longhorn [8] has calculated the work needed to accelerate slowly in an inviscid fluid a rigid sphere from rest to a velocity c_o in the t_o. He found that over and above the expected $1/2m^{\star}c^2_o$ where m is representing the mass of the sphere an additional 1/2 m $1/2\ m^{\star}\ c_o2$ kinetic energy was required in which $m^{\star}$ stands for the mass equal to one half that of the air dispaced by the sphere. If no compressibility of air occurs this extra amount of energy may be recovered when a slow decelaration is secured. If however a fast acceleration occurs, so compressibility starts to play a role and an additional amount of energy is needed which must take the form of radiated sound. Thus the maximum of the radiated energy when halting a sphere in a very short t_o time is $1/4\rho_o\ (V)\ c_o^2$, which is the available $1/2m^{\star}\ u_0^2$ extra energy travelling with the sphere. V stands for the volume of the sphere and ρ_o represents the density of the air. Since usually at an impact one body is decelerated while the other is accelerated, it sounds reasonable to assume that the maximum value for the accoustically radiated energy must be $1/2\ \rho o\ V\ c_o^2$. Taking it as a reference the acoustic effeiciency.

$$\eta_{acc} = \frac{E_{acc}}{\frac{1}{2}\ \rho o\ Vc^2{}_o}$$

will tend towards one, if E_{acc} denotes the radiated energy. Note that it is very useful to know that since $\rho_{steel}\sqrt{}\ \rho o \approx 1.5 \cdot 10^{-4}$ the sound energy will never exceed $1.5.10^{-4}$ times the kinetic energy of the impactor.

The general relation peak sound pressure and impact duration (the actual contact time) t_o was ginen by Koss and Alfredson [9] which smoothly closes to Longhorn's results when low frequency approximation is applied. Richards et al [10] based on the above mentioned theories worked out practical expressions supported by experinmental evidence. Proving that there is a good chance to replace the radius of the spheres by the actually accelerated body 's $(volume)^{1/3}$, the undimensional form of the p̂ peak pressure at a distance r with «a» denoting the velocity of sound will be

$$\frac{\hat{p}\cdot r}{\rho_o a c_o (vol.)^{1/3}} = 1.5\ \sqrt{\{at_o/(vol)^{1/3}+4}}$$

Since experimental points - containing colliding cylinders, cones etc. hence far from being spheres - lie under these values, a simple upper limit is indicated by

$$\frac{\hat{p}r}{\rho_o a c_o\ (vol)^{1/3}} = 0.7 \qquad \text{for} \quad \frac{at_o}{(vol)^{1/3}} = \delta \leq 1$$

$$\text{and } 0.7\delta^{-2} \quad \text{for } \delta > 1.0.$$

To change this result into a minimum peak sound pressure one has to rewrite the expression in the form.

$$L = 10 \lg \frac{\hat{p}^2}{(2\cdot 10^{-5})^2} \ [dB]$$

But since the legal limits are marked in dBA the A-weighting has to be applied. Following Koss and Alfredson's suggestion the peak amplitude of the pulse may be expected at $f_A = 76.1/R$ for colliding metal spheres with radius R, which is the same as $f_A = 1/2\ t_o$. With this, the A-weighting correction read at f_A and marked by C_A [10]:

for $\delta \leq 1$

$$L_{w\,min} = 117 - 20 \lg r + 23 \lg c_o + 20 \lg (mass) - C_A\ [dBA]$$

in which the volume in the previous expressions have been replaced by the mass in kg-s of the impactee or impactor. Hard blows ($\delta<1$) may be calculated in a similar way by.

$$L_{w\,min} = 117 - 20 \lg r + 20 \lg c_o + 7 \lg (mass) - 40 \lg \delta - C_A\ [dBA]$$

Following the train of thoughts one may soon reach conclusions. Considering the usual distance between the workpiece and worker at the moment of contact r, the impulse (mc_o) required by technology, and over and above forseeing die hard blows ($\delta=1$), every pair of m, c_o will represent an L_{min}, hence a peak sound pressure level which cannot be avoided and should be called therefore the minimum noise of the machine.

It may be useful to draw attention to the importance large hammer mass (m) should be preferred to high impact speeds. Similar minimum levels may be obtained for the daily equivalent levels $L_{eqmin,}$ as well, if process repetition rates and the rate of hard and soft blows are known or estimated.

Should the acceleration noise be kept at a low level the dominating machine noise will be the ringing noise of the machine. The 1—2% of the kinetic energy not absorbed by the forming process but changed into flexural vibrations may find highly radiating machine parts causing sometimes even 30 dBA higher noise than that of acceleration. There is no minimum noise level to be accepted in this field, since - even if only theoretically - excess kinetic energy should not exist or should be absorbed before being radiated.

References

1. CUTIN, L.: NACA TIM 1195 (1948)
2. DOAK, P.E. — VAIDYA, P.G.: Journal of Sound and Vibration, 9,192 (1969).
3. SHARLAND, I.J.: Journal of Sound and Vibration, J, 302 (1964).
4. LIGTHILL, M. J.: Proc. Roy. Soc. London (A/211) 1952/222/1954.
5. CURLE, N.: Proc. Roy. Soc. LondonA/231/1955.
6. SZENTMARTONY, T. — KURUTZ, I.: 9th International Congress on Acoustics. Madriad 49—VII 1977 F.8.
7. SZENTMARTONY, T. — KURUTZ, I.: Proc of the Sixth Conference on fluid Machinery, 2,1169 (1979).
8. LONGHORN, A.I.: Quarterly Journal of Mechanincs and Applied Mechanics 5,64 (1952).
9. KOSS, L. K. — ALFREDSON, R. J.: Journal of Sound and Vibration, 27,59 (1973).
10. RICHARDS, E. J.— WESTCOTT, M.E. —JEYAPALAN, R.K.: Jounal of Sound and Vibration, 62, 547 (1979)

BUYING NEW MACHINERY

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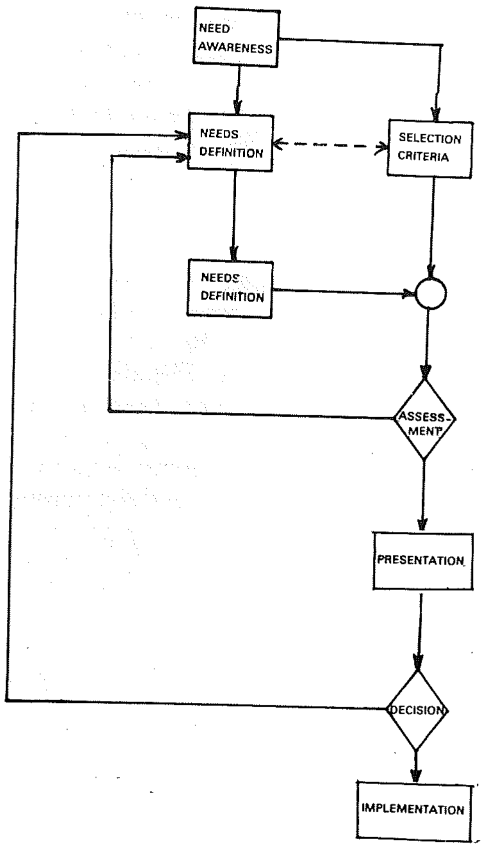
Buying new machinery is a facet of business behaviour which is of decisive significance to the healthy development of any manufacturing concern. Despite this, it is rarely given adequate consideration, resulting in serious problems such as inferior product quality, low productivity, incompatibility, high costs; with their inherent adverse effects. Of course, buying a new machine or indeed the decision whether to buy or not, is always a difficult one involving, inter alia, real commercial and technical risks. This renders the decision process cumbersome and very often the skills required on behalf of the investor are non existent or would be expensive to acquire.

This article discusses a means of applying simplified academic theory to the process of deciding whether to acquire new machines. It is intended to identify what needs to be done and to highlight areas that may warrant extra attention depending on the investment under examination.

The aspects covered are presented under the following headings:

— Is there a need to buy new macninery?
— Defining the need.
— Establishing the selection criteria and their importance.
— Assessment.
— Final presentation.



Is there a need to buy new machinery?

Very often a bad selection is the result of wrong definitions given to the needs and wants of the company. This is invariably due to the lack of a control system, within the production function, which would monitor and record the utilisation levels and performance of the machinery already in use. The decision maker is therefore in a situation where no comparative information is available on which to base a technoeconomic justification exercise. In addition to the above problem is the lack of strategic planning which will give a reasonable indication of the manufacturing capability needs within the foreseable future.

Hence what is required to enable a reliable definition of the needs of the company rather than the wants of the enterpreneur, is:

a) Keep reasonable records of the operation of the machines in use.

b) Forecast the future, in terms of manufacturing capability needs.

Defining the need

The need for new machinery may, inter alia, stem from:

a) The necessity for increased capacity.
b) Requirement for better accurancy/finish.
c) A change in technology.
d) Obsolete machinery resulting in prolonged downtimes, excessive scrap, impaired productivity and quality.
e) Lack of skilled labour.
f) Amendments on product design.

The investor should keep a close eye on all the above and the other factors-both within the company and outside-especially on all changes that may affect his company. This together with a good knowledge of the existing capabilities should enable him to define the generated needs. It is at this stage that the ability of the enterpreneur to "forecast" the future, on the basis of the trends, will prove very useful.

Establishing the selection criteria and their importance

Having defined the need, or indeed the needs, the enterpreneur is ready to establish the selection criteria and their importance. The criteria should be based purely on the identified needs and should in no way be affected by other factors such as a biased enterpreneur. In this connection it is advisable to form a selection panel within the company; this panel should include people from different departments and different attitudes.

The selection criteria, for any exercise may be identified under two distinct groups; vide licet, quantifiable and non quantifiable. As the description implies quantifiable criteria can be given numbers which can be easily compared, such as speed, feed, accuracy, space requirements etc. Non quantifiable criteria are basically judgemental and cover items such as machine ease of use or reliability, after sales service etc.

The importance or weight of each criterion will depend on the list of needs already prepared. Each criterion will be assigned a weighting factor according to its relevance or importance attached to it.

Assessment

It has already been mentioned that a technoeconomic study should be commissioned prior to any action, pertaining to the investment in machinery. The technical aspects (quantifiable and non quantifiable ones) have already been dealt with. The economic study would involve a financial analysis which would by necessity rely on technical figures such as speed, tool life, degree of automation etc.

As far as the technical characteristics are concerned the weight given to each criterion must be analysed in a suitable manner which should generate comparative information so that different alternatives may be compared against each other. It should at this stage be recalled that the weight assigned to each criterion will be a reflection of the needs analysis and the establishment of criteria phases. Obviously if the wrong needs are identified, the wrong criteria and weights will be set and the wrong selection will be made.

Consequently it is important for a serious organisation to set quidelines for the monitoring of needs and setting of criteria leading to standardised assessment procedures.

Moving now to the financial or economic part of the exercise one always tends to look at the suppliers' quoted selling price.

Invariably this will not include any form of guidance as to the need for:

b) Tools or special attachments
c) Maintenance costs
d) Cost of needed labour.

At all times an exercise must be carried out evaluating the cost of the proposed investement (both capital and operating costs) against the likely benefits. The net of these must be compared with the present situation.

It is a fact of life that all investment decisions should be made on the basis of a reliable viability study, ie the bottom line figures are the financial ones at all times. Of course what is often forgotten is that money figures are useless unless supported by suitable technical study. Changes in the cost of labour, or scrap rate or machine time for example are determined only through a study of the technical characteristics. Estimates with loose confidence limits may give rise to grossly misleading bottom line figures.

Final presentation

Sometimes the person who carries out this selection exercise is not the one to take the final decision (of course both sides could be a team of people). For this reason the presentation of the findings should:

a) Set out clearly the reasons behind the exercise.
b) State clearly all bases for the calculations.
c) Offer clear recommendations.

For these reasons it would be prudent for a firm to have a manual or guidelines as to the final presentation of recommendations concerning the possibility of investing or not in new machinery. It should be clear by now that these quidelines would be a natural continuation of formalised procedure for the preceeding stages.

Conclusions

Buying new machinery is a very important part of an enterpreneur's job and one which could have considerable consequences on the future development of the company. The decision to buy new machinery or not should be treated as such at all times. Invariably the best way to do it is by adhering to formalised procedures which can be developed using the experience of the company.

Computer Software for Structural Analysis and Design

Frame Analysis and Design Program

A comprehensive program for any structural shape, any loads, loading generation, envelopes for moments, shears, reinforcement and links, temperature effects, support settlements, shear wall element, spring element, internal pins, design to BS8110, CP110, CP114, ACI318 and Greek code. All units available. Graphical plots of shape, deflections, envelopes of moments and shears with automatic scaling.

Continuous Beams, Slabs and Subframe Analysis & Design Program

A comprehensive program for continuous beams, slabs and subframes of any shape and loads, loading generation, envelopes for moments, shears, reinforcement and links, temperature effects support settlements, spring elements, internal pins, design to BS8110, CP110, CP114, ACI318 and Greek Code. All units available. Graphical plots of shape, deflections, envelopes of moments and shears with automatic scaling.

Truss Analysis Program

A comprehensive program for any truss, any loads. envelopes for moments, shears and end effects, temperature effects, support settlements, spring elements. Graphics.

Retaining Wall Design Program

This program designs stemmed retaining walls.

Continuous Beam on Elastic Foundation Analysis & Design Program

A comprehensive program dealing with variable contact width, and variable modulus of subgrade reaction, any loads, envelopes for moments, shears, reinforcement and links, design to BS8110, CP110, CP114, ACI318 and Greek Code. All units available.

Earthquake Analysis Program for Shear Walls and Frames

This program evaluates centres of rigidity, allocates direct & torsional shears to shear walls and frames and then allocates frame and wall total base shears to each floor level.

This program handles three types of analysis from the cantilever shear wall model, the single storey model and the sophisticated analysis of the multistorey model.

Slab Analysis & Design Program

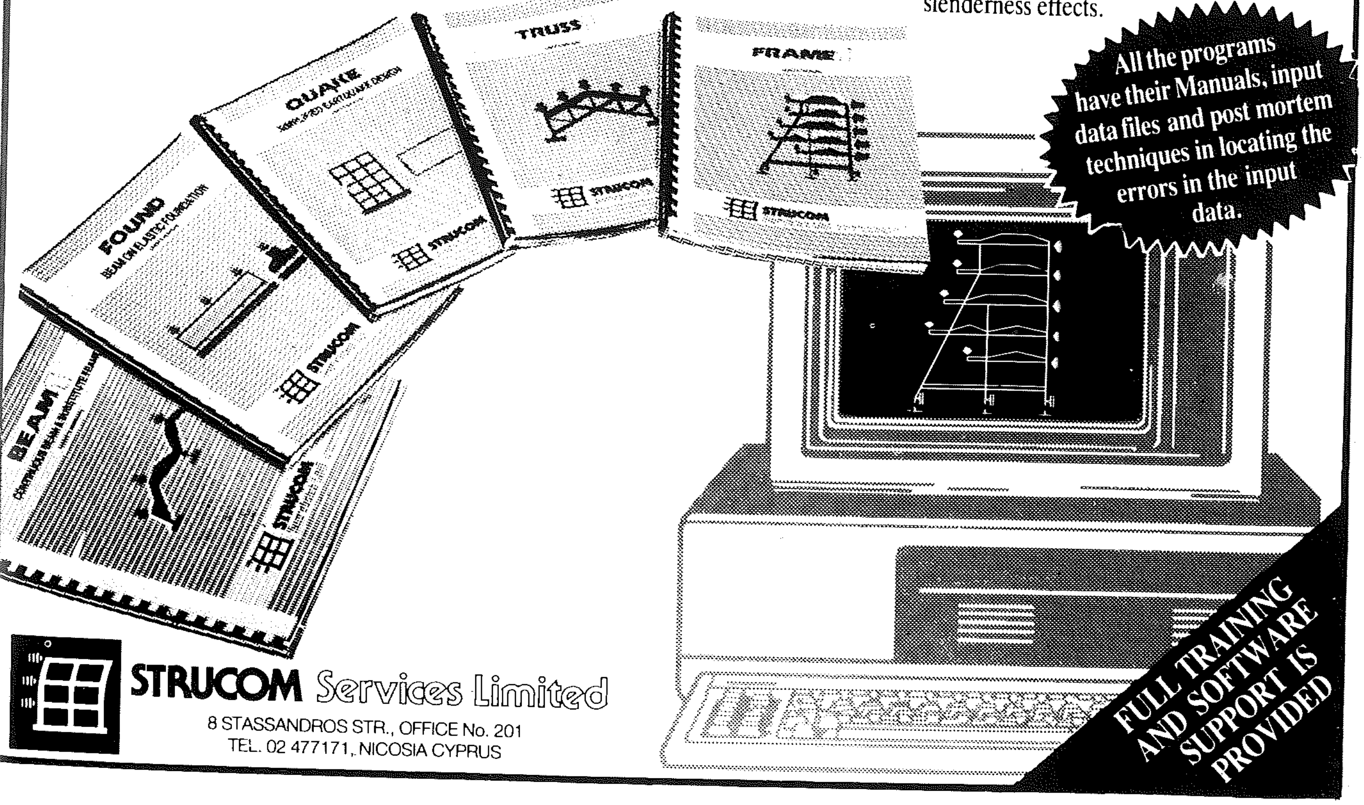
This program offers analysis and design of rectangular slabs and with any type of support continuity.

Footing – Wall Base Design Program

This program designs column footings and wall bases for axial forces and bending moments.

Column Design Program

This program designs any rectangular column for moments and axial loads including moments due to slenderness effects.



All the programs have their Manuals, input data files and post mortem techniques in locating the errors in the input data.

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SMALL BOAT POWERING

A Simplified Approach

by Costas Neocleous, B.E., M.Sc.
Lecturer Mechanigal Eng. Dept., H.T.I.

This article presents a very simple way of estimating the power requirements, of small boats. It is used by some yacht designers as a quick method of getting results.

For more accurate predictions, the results of experiments in towing tanks or Systematic Series must be used.

General Introduction:

To find the engine power requirement (brake power) we use:

$$P_B = P_E/\eta \qquad (1)$$

where P_B= Brake Power

P_E=Effective Power

η= Propulsion Efficiency from P_B to P_E

and $P_E=R_T V_s$ (2)

where R_T= Total Hull Resistance at V_s

V_s= Boat Speed

The Total Resistance is the sum of a number of componets:

$$R_T=R_f+R_w+R_{eddy}+R_{form}+R_{air}+R_i+R_h \qquad (3)$$

where

R_f=frictional Resistance

R_w=Wave making Resistance

R_{eddy}=Eddy-making Resistance. (Due to vortices generated by the boat).

R_{form}=Form Resistance (Due to flow separation)

R_{air}=Air Resistance

R_i=Induced Resistance (For Sailing Yachts)
R_h=Heel Resistance

Equation (3) may be rewritten as

$$R_T=R_f+R_r \qquad (4)$$

where $R_r=R_w+R_{eddy}+R_{form}+R_{air}+R_i+R_h$= Residual Resistance

The greatest contribution to R_r is due to wave-making.

Estimation of P_B:

(a) Displacement Boats:

The three most important parameters are speed, length and displacement.

Figure 1 can be used to help us estimate the total resistance R_T.

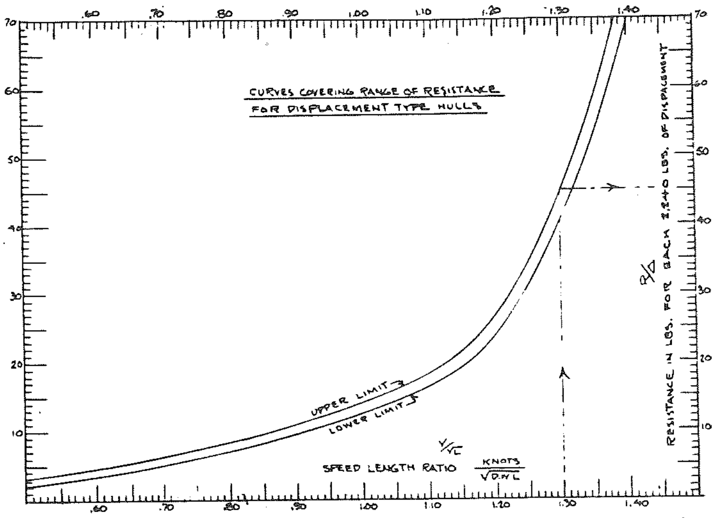

Fig. 1

In this figure:

DWL=Design Water Line in feet

V=Boat Speed in knots

(1 Knot= 1.151 mph=0.54 $\frac{m}{s}$)

$R=R_T$= Total Resistance in lb_f (1 lb_f=2.205 kg_f)

Δ=Boat Displacement in ton_f (1 ton_f=2240 lb_f)

This is the weight of the displaced water, i.e. the weight of the boat.

Example:

Let a boat of DWL=29´ (=8.8 m) and Δ=22,000 lb_f=9.8 ton_f

If the required speed is 7 knots, what is R_T, P_E and P_B?

Solution:

At 7 knots and 29´ get

$$\frac{V}{\sqrt{L}} = \frac{7}{\sqrt{29}} = 1.3$$

From figure 1 at this value we get

$$\frac{R}{\Delta} = 45 \rightarrow R_T = 45x9.8=441\ lb_f$$
$$=134.4\ kg_f$$

The Effective Power is:

$$P_E = 0.003xRxV \qquad (5)$$

where

P_E= Effective Horse Power

R_T= Total Resistances in lb_f

V= Boat speed in knots

0.003=Conversion Factor

Thus P_E= 0.003x441x7=9.26 hp.

In order to find the power of the engine needed, we need to know the overall efficiency from P_B to P_E. This depends mostly on the efficiency of propeller. For simplified calculations we can use the following approxicimate values:

TYPE OF PROPELLER	η
2 bladed Folding (Harreshoff) Propeller	0.10
2 » solid »	0.35-0.45
3 » solid »	0.50-0.65

In this example, if η=0.35 the engine needed is:

$$P_B \text{ in hp} = \frac{9.2}{0.35} = 26.4\ hp$$

(b) Planing Boats

The following formula, known as Keith Formula has been used:

$$P_B = \Delta \left(\frac{mph}{10C\sqrt{L}}\right)^3 \qquad (6)$$

where

P_B = Brake Horse Power

Δ = Boat Displacement or Weight in lb_f

mph = Boat Speed in miles per hour

L = DWL

C = 1.3 to 1.5 depending on the size of boat.

Example:

Speed boat of 40 ft DWL and 24000 lb_f displacement. What brake horse power is needed to give a speed of 20 mph?

Solution:

Using a C=1.4,

$$P_B = 24000 \left(\frac{20}{10x1.4\sqrt{40}}\right)^3 = 276\ hp$$

Thus use two engines of 138 bhp each.

COMMUTATION OVERLAP AND DISTORTION IN 3-PHASE CONTROLLED BRIDGE RECTIFIERS

by S. Hadjioannou, MSc Power Electronics

Lecturer HTI/RTC.

The introduction of Power Electronics for industrial applications during the last decade has been quite siqnificant. The problems arising from such applications concentrate mainly on the distortion of the mains for which special regulations are necessary in each country for eliminating this distortion. One of the most common circuits in Power Electronics applications is the 3-phase Rectifier. For eliminating mains distortion in 3-plase Rectifiers, their operation and the way they cause such distortion have to be examined.

In order to generate a controlled dc output voltage V_L, the thyristors T1 to T6 are fired in sequence. The related voltage and current waveforms are shown in fig. 2. The conduction period for each thyristor is 120^0 which for a 50 Hz supply corresponds to 6.87 ms. The turn on and turn off times of each thyristor is of the order of microseconds. These times compared to the time constant of industrial inductive loads are negligible and so the load current I_L is considered constant throughout the turn on and turn off process of thyristors. This is due to the fact that inductances oppose any change of current through them by generating a voltage L di/dt having such polarity so as to oppose the change.

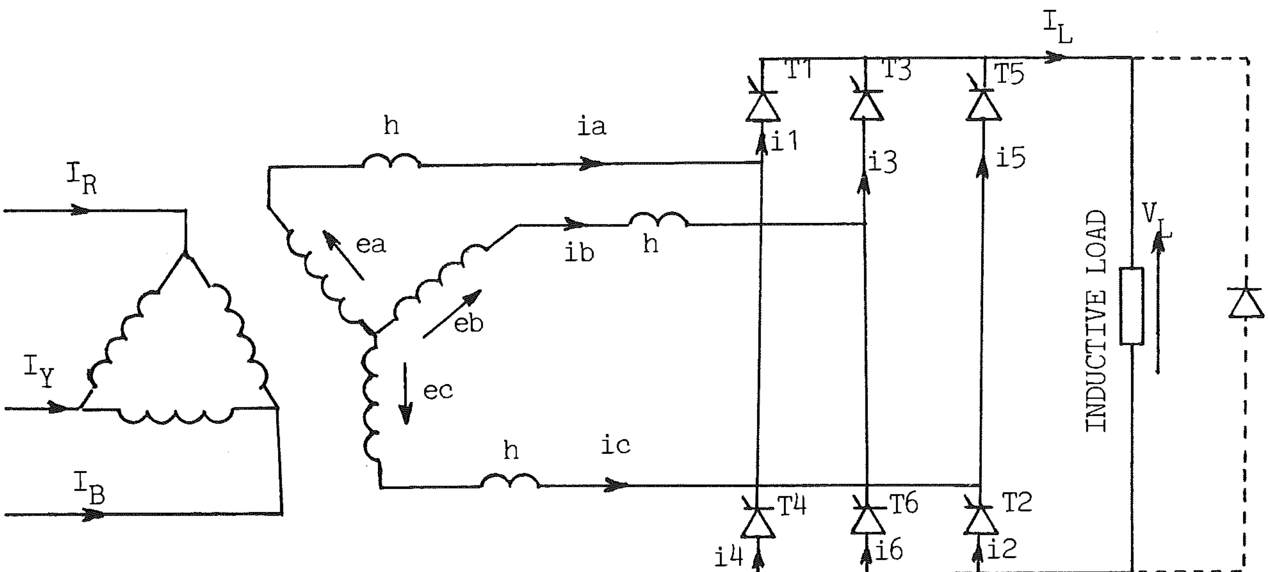

Fig. 1. 3-phase controlled Bridge Rectifier.

The total line and transformer inductance have been reflected in the secondary of the delta/star transformer as shown in fig 1. This inductance has a finite value h and has not been taken into consideration in the basic waveform analysis shown in fig. 2. However looking at the supply currents IR, IY and IB, it is evident that their waveforms are full of harmonics and this is one of the main factors contributing to the harmonic distortion of the 3-phase supply. If the transformer connection adopted was a star/star one, then the IR, Iy and IB current waveforms would have been similar to Ia, Ib and Ic, as shown in fig. 2, which is a much worse case. So the delta/star connection adopted was a factor contributing to the elimination of harmonics. More complicated transformer connections such as a double star secondary with interphase reactor can help towards harmonic distortion elimination.

When a thyristor of the Bridge Rectifier of Fig. 1 is fired, current I_L is commutated (transferred) from the previously conducting to the newly fired

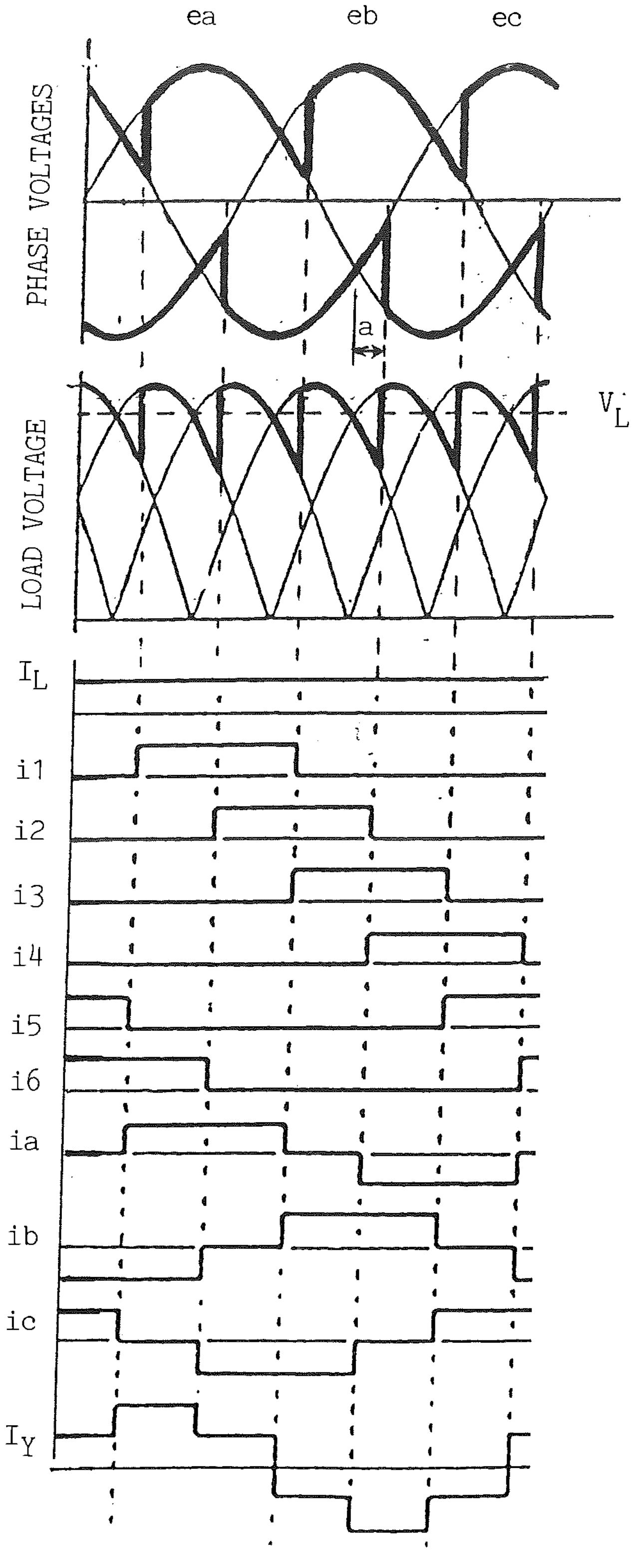

Fig. 2 Idealised Waveforms for a 3-phase controlled Bridge rectifier.

This is due to the fact the line inductance h prevents the current in the one thyristor to drop instantly to zero and rise instantly to value I_L in the other. This forces the two thyristors, say T1 and T3, to be on during the commutation period which is a short-circuiting condition across the correcponding two a.c. lines, as shown dotted in fig. 3(a). This condition is known as the overlap of currents during commutation or "commutation Overlap".

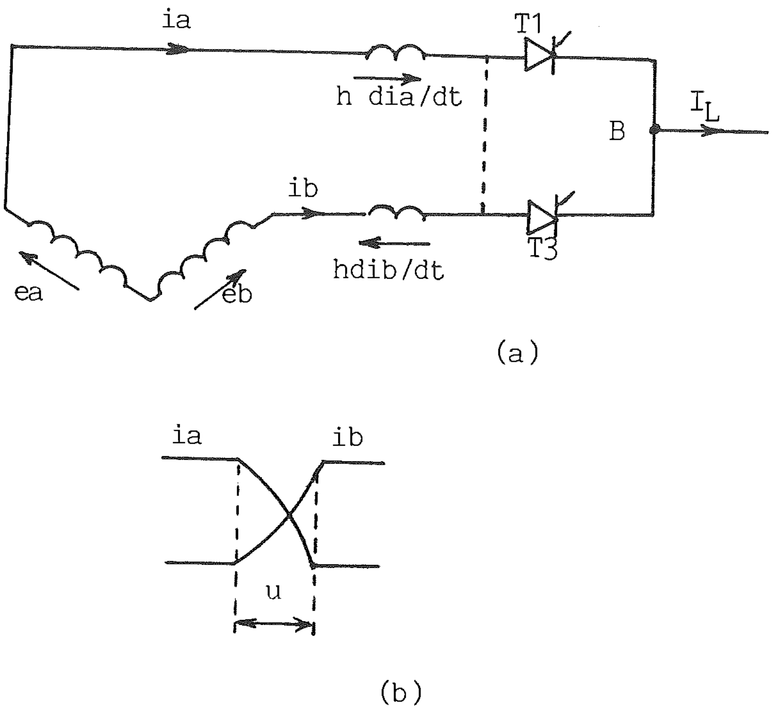

Fig. 3: Commutation overlap in 3-phase Bridge Rectifiers

Mathematical Analysis of Commutation Overlap

let $\delta = \alpha + u$

from fig. 3, using Kirchoff's law:

$ea + h\, dia/dt + hdib/dt - eb = 0$ 1

but $h\, dia/dt = h\, dib/dt$, from fig 3(b)

So eqn 1 becomes

$(eb - ea)/2 = h\, dia/dt$ 2

Voltage at point B of fig. 3 (a) is:

$V_B = ea + h\, dia/dt = ea + (eb - ea)/2$

$\therefore V_B = (ea + eb)/2$ 3

Equation 3 justifies the distortion of the waveform at point A of fig. 4, since the voltage instead of rising to a value eb, when T3 is fired, it goes to a value (ea+eb) /2 until commutation overlap is over. Since the voltage value (ea+eb) /2 is less than eb there is reduction of the output dc voltage. This reduction is proportional to the area δA shown shaded in fig. 4.

$$\delta A = \int_{(5\Pi/6)+a}^{(5\Pi/6)+\delta} [eb - (eb+ea)/2]d\theta = \int_{5\Pi/6)+a}^{(5\Pi/6)+\delta} (eb-ea)/2 \, d\theta$$

$$\delta A = \int_{(5\Pi/6)+a}^{(5\Pi/6)+\delta} [E \sin(\theta - 120^0) - E\sin\theta]d\theta =$$

$$\delta A = \int_{(5\Pi/6)+a}^{(5\Pi/6)+\delta} \sqrt{3}/2 \; E \sin(\theta + \Pi/6) \, d\theta$$

$$\therefore \delta A = \sqrt{3} \; E \, (\cos a - \cos \delta)/2 \qquad \text{.......... 4}$$

and mean dc voltage lost is

$$3\delta A/\Pi = 3\sqrt{3}E \; [\cos a - \cos\delta]/2\Pi$$

but the output of a fully controlled bridge without overlap

is: $(3 \sqrt{3}E \cos a)/\Pi$

So the actual dc output of the bridge now becomes:

$$V = 3\sqrt{3}E/2\Pi \; [\cos a + \cos (a+u)] \qquad \text{.......... 5}$$

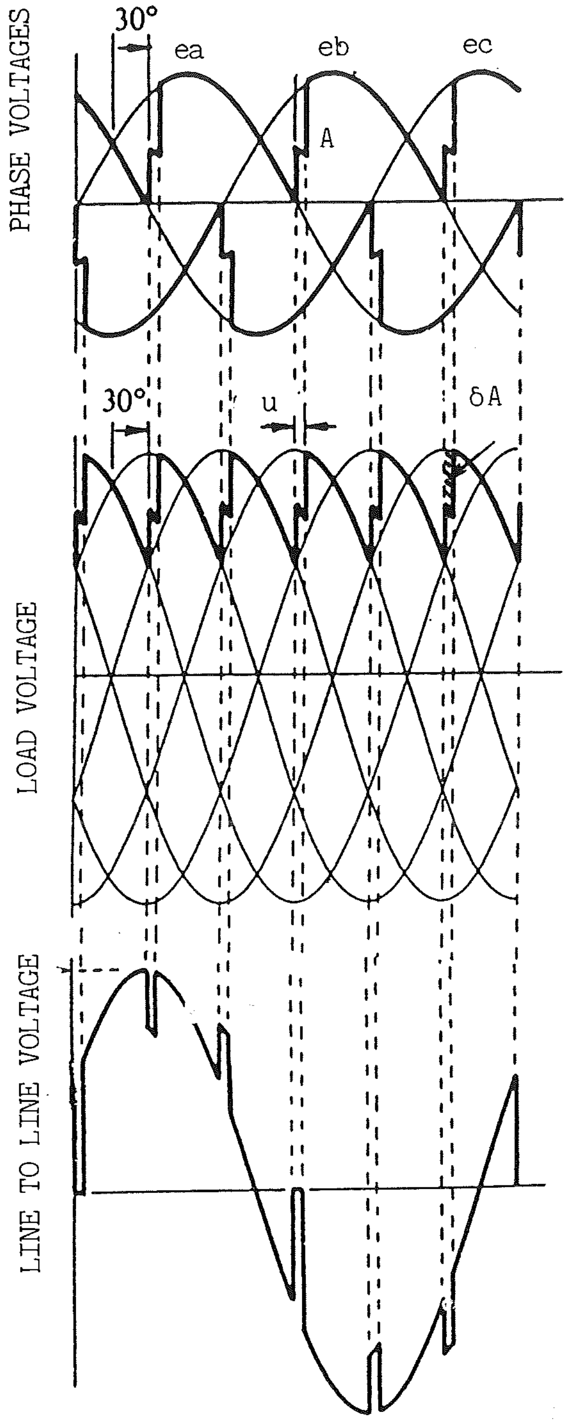

Fig. 4: Waveforms of a 3-phase controlled Rectifier with commutation overlap

Apart from the dc output voltage reduction due to the commutation overlap the distortion of the supply line voltage waveform, as shown in fig. 4 is terrible. The best way for improving this bad situation is by connecting a diode in inversse parallel across the load. This commutating diode as it is called is shown dotted in fig. 1 and it undertakes temporarily the load current. The load current flows in the same direction in the inductive load and of course it continuous to have the same value and so the load inductance will not object to this temporary change. The diversion of the load current away from the outgoing thyristor T1 allows it to turn off very quickly and so the commutation overlap is reduced considerably.

Summarising in simple words the construction and use of 3-phase rectifiers by unqualified people,apart from the troubles they will cause to their neighbours they might come and complain to the Electricity Authority for a bad quality 3-phase power supply.

HTI CALENDAR OF EVENTS

Academic Year 1986-87

by E. Michael

SEPTEMBER

- Lectures commenced on Monday 15th September. Five hundred and eighty seven (587) students enrolled for this academic year.
- Dr T. Drakos, Head of the Electrical Engineering Department, was invited by the IEE (U.K.) and participated in the conference of newly appointed overseas representatives of the IEE Council held in London.
- Mr D. Lambrianides, Lecturer in Electrical Engineering has been awarded a scholarship by the British Technical Cooperation Training Programme for MSc studies at Hatfield Polytechnic in Digital Systems.
- On the 25th September Dr Modjtabai visited HTI and discussed the future prospects of the collaboration of the World Health Organisation (WHO) with the Regional Training centre (RTC) of the HTI.
- On the 26th September all the extra - curricular activities of the HTI started.

OCTOBER

- The HTI Director participated in a mission to the Democratic Republic of Germany for the week 9—15th October 1986 in his capacity as the President of the Pancyprian Organisation of Teachers of Tertiary Education.
- Mr A. Kaplanis, Lecturer in Electrical Engineering was awarded a scholarship for MSc studies in Medical Electronics and Physics at the Department of Medical Electronics, St Bartholomew's Hospital, London.
- Mr J. Michaelides Senior Lecturer Mechanical Engineering Department visited France for one month for familiarisation with the latest developments on Solar Refrigeration and Air Conditioning.
- An endorsement course on Quantity Surveying started on 6th October 1986.
- On 18th October students and staff donated blood for the Blood Bank of the Nicosia General Hospital.
- The HTI students decided to abstain from classes in support of certain claims they have put forward to the HTI management and particularly for the total abolition of tuition fees at the institute.

NOVEMBER

- A course on Trouble Shooting Microprocessor Based Systems was organised by the IEE (Cyprus branch), the Polytechnic of Central London (PCL) and the Industrial Training Authority and took place between 20—24th October 1986.
- An excursion to Ayia Napa was organised by the HTI Welfare services for the foreign students of the HTI.
- On 7th November the students decided to return back to their classes after an agreement was secured regarding their claims.

DECEMBER

- Mr Chr. Markou went for a training course on Mechanical and Chemical Testing of Leather and Footwear Materials and Quality Control Systems used in footwear Industry, in Athens, Greece.
- Classes were suspended on 23rd December for the Christmas holidays.

JANUARY

- Classes commenced again on Tuesday 7th January after the Christams holidays.
- On 15th January the HTI Director Mr. G.D. Christodoulides was promoted to the post of Director of Technical and Vocational Education, Ministry of Education and left the HTI after a continuous service of 18 years.
- The first semester exams are held between 16—29th January.
- Mr C. Paikkos of the Quality Control Footwear and Leather Testing Centre at HTI acted as counterpart of the expert Ms Jane Humphries and assisted in the collection of the necessary information for her report on the effects on the Cyprus Footwear Industry of the proposed Customs union of Cyprus with the EEC.
- Mr P. Vasiliou, Senior Lecturer Civil Engineering Department participated in the Annual Conference of IAESTE in Budapest, Hungary between 14—20th January.

FEBRUARY

- Classes for the second semester commenced on Tuesday 3rd February.
- Three specialised courses were organised by the Electrical Engineering Department in collaboration with PCL and the IEE Cyprus Branch in the areas of Trouble Shooting Microprocessor Based Systems and Programming and Interfacing microprocessors. An endorsement course on Digital Electronics started also by the same Department.
- Three experts from USA came at the HTI through the Fulbright Commission.

  Dr. Robert Brown, Professor at Colorado School of Mines in Computer Engineering was assigned to the HTI for five months to assist in the organisation of the Computer Science course.

  Dr Floyd Delon, Professor of Educational Administration at the University of Missouri, Columbia was assigned to the HTI to study and advice on the possible introduction to the HTI of the Credit Point System.

  Dr. Michael Harris, Assistant Professor in Electrical Engineering Department of the University of Central Florida, was assigned to the HTI to assist in syllabus revision, advice on the selection of laboratory equipment and train Lecturers in some areas of electronics.
- Mr. E. Michael, Lecturer Electrical Engineering Department, has been awarded the degree of MSc from the University of Salford (U.K.) after successful completion of his thesis on Efficient Utilisation of Machine Drives in the industry of Cyprus.

MARCH

- Mr P. Chrysostomou, Senior Instructor and C. Christofi Instructor in Mechanical and Marine Engineering were offered a four months scholarship in Numerical Control Techniques by the European communities to take place in Dublin Ireland.
- Dr Stuart Freak of the Open University U.K. visited RTC and discussed the final details of a PhD project on biomagnetic Measurements to be carried out in collaboration with HTI.
- A full day excursion to Limassol for the Big Carnibal parade was organised for the overseas students of the HTI. The excursion included also a visit to the Archaeological Museum, the Limassol castle and the Kolossi castle.
- Mid-semester examinations took place between 30th March and 6th April.
- On 19th March the Council of Ministers announced its decision to extend free education to the HTI by the next academic year 1987/88.

APLIL

- Classes were suspended for Easter holidays between 15—24th April.
- The second annual blood donation for the needs of the Blood Bank of Nicosia General Hospital was held on 13th April.

MAY

- Industrial training of the third year students ended on May 22.
- final Examinations for the final year students were programmed to be held between 22nd May and 3rd June.
- Dr. A. Mallouppas Head RTC visited WHO Headquarters in Geneva to prepare on behalf of WHO a «Global Action plan» on the management of maintenance and repair of health care equipment. The proposed project is of 5 years duration and estimated at US $ 3—4 million.
- It has been approved by the Eastern Mediterranean region of WHO for RTC to become a WHO collaborating centre on maintenance and repair of health care equipment. Such recognition is usually given to Institutions who are unique in their field.

JUNE

- Final examinations for the First and Second year students were programmed to be held between 4—18th June.
- Final year projects were programmed to be handed in by June 17th and oral interviews to take place between 22—26th June.
- The Graduation Ceremony was scheduled for Friday 3rd July.