J Indian Inst. Sci., Mar–Apr 1988, 68, 159–165
Indian Institute of Science

BOOK REVIEWS

Soviet space programs 1980–1985 (Vol. 66, Science and Technology Series) by Nicholas L. Johnson. Published for the American Astronautical Society by Univelt, Inc., P.O. Box 28130, San Diego, CA 92128, 1987, pp. 298, $ 55.

Yuri Romaneako safely returned to earth, in the Soyuz T.M.3 space capsule on December 29, 1987 after a record 326 days in space aboard MIR, the Soviet space station, which earlier in February 1986 had replaced the older Salyut. There were 91 Soviet space launches in 1986, accounting for 88 per cent of the world total. In 1987, the Soviets accomplished 95 launches compared to eight by the US, three by Japan, two each by China and Europe.

Included in the 1987 Soviet launch total were four for science, ten geosynchronous missions for the Molniya, Ekran, Raduga, Gorizont and Kosmos communications systems, 36 photo-reconnaissance and earth-resources missions, 17 supported military missions, ten docked with the MIR stations and five test launches of the SL-16 medium lift booster. Although USSR space activities have sustained a high tempo ever since Sputnik, the world's first artificial satellite, information about them until recently, has been sketchy and generally difficult to get and often subject to cold war distortions. To professionals engaged in space-related activities the main sources of information about the Soviet programme have been western publications and reports and less accessible, translations of Soviet space literature.

Among the early Western observers of the Soviet satellites was the amateur group led by G. E. Perry at the Kettring Grammar School, Northamptonshire in the U.K. Starting with visual observations based on daily newspaper news, Perry and some of the science staff and students of the school began to observe, photograph and record radio signals from the early Sputniks. By the mid-60s, with the acquisition of some electronic equipment, Perry was able to deduce the orbits and some aspects of the missions of the Soviet satellites and also the location of a hitherto undisclosed location of a third Soviet launch site within the Arctic Circle. The group was also able to decipher the complete telemetry message from a navigation spacecraft in the Kosmos series. Soon the official tracking agencies in the West began to use the Kettring Group's analysis and predictions of Soviet missions as an authentic and reliable source of supplementary information on Soviet space missions — often more un-biased than official sources and a tribute to the curiosity, perseverance and ability of human beings!

In the USA, apart from the US Department of Defence and NASA, many professional societies and individuals have studied aspects of Soviet space activities and written about them. N. L. Johnson and James Oberg are among the most active Soviet space watchers and writers on the subject. Johnson has earlier authored the *Handbook of Soviet lunar and planetary exploration* (1979) and the *Handbook of Soviet manned space flight* (1980). In association with Teledyne Brown Engineering he has been involved with the publication of annual reports since 1981 entitled *The Soviet year in space*. The present volume published by the American Astronautical Society consolidates and updates the information contained in the earlier publications. Starting with an overall overview the book is organized into five major sections each being introduced by a summary covering the subject of the section over the years 1980–85. Six appendices provide supplementary information on the overall Soviet manned flight programme, international space treaties and Soviet drafts presented at the UN Committee on Outer Space, etc. The coverage of the five major sections is fairly comprehensive — Launch vehicles, Launch facilities, Spacecraft — civilian, scientific, military and man-in-space programmes all are described and discussed — including some "unknown" missions.

The overview provides a glimpse at the main features and scope of the Soviet space programme. The high rates of launch are associated with the wide range of missions and with relatively shorter operational life times of satellites — on the average less than two years. Western observers usually ascribe the shorter life times to an inferior technology. While there is probably some truth in the superiority of US space technology especially in microelectronics and computer systems the Soviet programme philosophy appears to be more a matter of deliberate, conscious choice. For example, by using larger numbers of modest, cheaper satellites for missions, rather than a smaller number of very sophisticated and expensive spacecraft the mission is less affected by the loss of a single spacecraft. Also the high launch rate establishes a means of space segment replenishment at short notice. Thus the Soviet system stands out as a very economically competitive one, with carefully laid long range plans being followed systematically. The bulk of Soviet space missions — nearly 75 per cent — in terms of launches appear to be dedicated to reconnaissance, earth observations, communications, navigation and weather satellites. The well-known Kosmos series alone has crossed the 1700 mark by now.

The chapter on Support systems covers launch vehicles, launch facilities and curiously, space surveillance. The Vostok, Soyuz, Proton and Kosmos class of launch vehicles and the western designators are briefly described and so are the currently operational launchers. It is interesting to note that the A-class booster had accumulated over 1000 launches by 1983. Of these three main launch stations, Baikonur (Kazakhistan) (also known as Tyuratam), Plesetsk south of Archangel in the north and Kapustin Yar near Volgagrad, Plesetsk is probably the busiest. The Indian satellites, Aryabhata and Bhaskara, were launched from Kapustin Yar, while the latest one — IRS-1A — is now at Baikonur ready for launch.

Chapter 3, the largest section in the book (159 pages), covers the Soviet space programme by a consecutive description of the photo-reconnaissance, communications, navigation and geodetic, meteorological and remote sensing and scientific space missions. Special sub-sections are devoted to dedicated military satellite systems, man-in-space missions and solar system exploration. The sub-section on photo-reconnaissance missions is particularly interesting as it cites the Soviet watch kept over trouble spots in the world — These include the Middle East with special attention to Israeli incursions, the Iran–Iraq conflict, the Falklands war, monitoring of the US landing on Grenada, the happenings in El Salvador and Panama area and the Afghanistan war, etc.

Soviet communications satellite systems are covered in sub-section 3.2 and demonstrate the extensive coverage — rom ham radio to national communications and military C^3I.... The Molniya system with highly elliptic orbits is particularly suited to the USSR's needs with its territory lying mostly in the northern part of the globe. After 20 years of service, the Molniya system still forms the backbone of the Soviet domestic communications network. However this has now been enhanced by geosynchronous satellites in the Ekran, Gorizont, and Raduga systems. The Ekran spacecraft, first launched in 1975, were the world's first true direct-broadcast television satellites. Transmitting in the 0.7 GHz band with 200 Watt power they cover the service areas of Siberia, the far east and the extreme north where relatively simple receivers receive the transmissions The second generation geostationary systems called GALS, LUCH and Volna are also covered. By 1985 although starting late, the Soviet Union had orbited more than 50 geostationary spacecraft. The Soviet Navigation and Geodetic Satellite System is broadly similar to the US Transit System. Relying on doppler techniques the system is designed for position location and apart from maritime shipping was primarily meant to assist ballistic missile submarines in establishing their exact locations. The system consists of a constellation of ten satellites at about 1000 km orbital altitude with six having orbital planes separated 30° apart and serving military needs. Four are for civilian use with orbital planes 45° apart. The right ascension of the civilian spacecraft is carefully positioned in the hemisphere opposite that of the military network. The Soviet Union participates in the International Search and Rescue Satellite System with the US, France, Canada and UK, Norway, Bulgaria and Finland as the other participants. This system is designed to locate and rescue survivors of crashed aircraft or ships in distress. The USSR and US are committed to maintain transponders on orbiting satellites. India has plans to join the system soon with a transponder on the INSAT-2 satellites. The Soviet Global Navigation System, Glonass, and the American Global Positioning System, GPS, currently being deployed are again basically similar systems with multiple satellites in circular semi-synchronous orbits in three orbital planes.

The Soviet Meteorological Satellite Programme starting in the sixties, was probably their first civilian applications project. The Meteor satellites send data to over 50 stations and the Hydrometeorological Centre processes this and puts out weather service information across the USSR. It is interesting to note that according to Soviet estimates weather satellites save almost a billion Rubles annually for the Soviet economy. It is perhaps interesting to note that as a part of the International Global Atmospheric Research Programme several countries had committed in 1975 the provision of geostationary meteorological satellites to be positioned so as to cover the globe. While the US, Europe and Japanese geostationary satellites are in position, for some reason the USSR spacecraft which was to be positioned in the Indian Ocean area, has not materialised. The gap has been filled by the meteorological instruments of INSAT-1B.

Johnson's speculation is that the Soviets have been studying the use of inclined geosynchronous satellites at 65° as these describe a pattern of motion more suitable to the USSR meteorological services. It should be noted that the Soviet Union is so far the only country with operational spacecraft carrying sophisticated side-looking synthetic aperture radar for data on polar ice conditions vital to Soviet merchant shipping operating in northern waters. Active microwave satellites are planned to be launched by Canada, Europe, Japan and India in the near future.

Section 3.6 covers in detail the dedicated military satellite systems. Taken along with the information available about the American military space systems one cannot help noting the enormous effort in technology, budgets and manpower being expended by the two super powers to keep abreast of each other's actions in knowing the status and extent of the ballistic missile systems these countries deploy and maintain as part of their nuclear deterrent strategies. Hopefully the public pressure of people everywhere would force the movement towards nuclear arsenals control and eventual reduction and release billions for more useful applications of space systems of benefit to people everywhere.

Section 3.7 dealing with Soviet man in space programmes is a good comprehensive description of what has always been a show piece of the Soviet space activities. Perhaps a summary of the Soviet findings on the physiological and psychological effects on human beings in space would have added value to the otherwise excellent narrative.

The USSR space effort has in the past, laboured away from the global public eye while the Western media have from time to time focused on the spectacular successes of the American space programme.

The Challenger accident in January 1987 followed by a series of Western rocket launcher failures and the public debates in the US has focused some attention on the steadily expanding USSR space activities. The recent launch of the Super-booster 'Energia' and the unmanned missions scheduled for the late 80s and 90s are impressive: probes to the Asteroids, Venus, the Martian moons, and the surface of Mars itself. In 1994 or 1996 a Soviet spacecraft will carry a long range rover to the Mars surface. A follow-up mission will attempt to bring back Martian samples.

The USSR is now active in promoting a range of space assets for civilian commercial use. Glavkosmos the new agency set up recently is internationally promoting space launches, offering communication channels on Soviet spacecraft. High resolution earth resource imagery is also becoming available from USSR space flights. Thus what can be seen are the results of a consistent long range space policy consistent with the USSR's national interests and international programmes.

Why is the Soviet Union so interested in space flight? Gorbachev recently visiting the most active launch site said "all of us Soviet people have always pronounced the word 'Baikonur' with special emotion. It became the symbol of our homeland's greatest exploit — the triumph of Soviet science and the great potential of the socialist social system ... it was from here that mankind first stepped into space opening a new page in the history of civilization ... we do not intend to slacken our effort and lose leading positions in space explorations."

If Konstantin Tsiolkovsky the Russian pioneer of space exploration were alive today, he might gaze at the stars on a clear evening and probably notice many tiny points of light moving against the background of the heavens. If he were to ask whose satellites were in the sky — the answer would be that over 80 per cent were of Soviet origin. Tsiolkovsky would be pleased.

All in all the author provides fairly comprehensive coverage of the USSR space programme and his hypotheses and observations about the nature of some of the missions — especially the military missions can be regarded as astute and credible. The discerning professional reader may find information about spacecraft and launcher design rather scant but otherwise very complete. The illustrations, photographs and diagrams and tables are good but could be better.

In summary the book is competently written, the information quite comprehensive and important to an understanding of the Soviet space programme. Policy makers and generalists in the space business will find it very useful. The professional designer, engineer or scientist would obviously need supplementary study from other publications.

Space Commission S. DHAWAN
Bangalore 560 009.

Microprocessors — Design and application by Debasis Das. Nem Chand & Bros., Roorkee, 1987, pp. 372, Rs. 45.

The book under review is "intended to cover the requirements of undergraduate courses on microprocessor based design" and its emphasis, according to the author is "on practical design and their realization". On the whole, the author has succeeded in meeting the stated objectives. He has managed to pack enormous amount of information into nine chapters and two appendices, spanning about 370 pages.

The book, however, suffers from unusually large number of printing mistakes, some trivial and some serious. Some logical errors also have crept into it. An errata of about 45 odd entries fails to capture even one fifth of the errors. Some examples: Page 13, Line 18: "interrnpts"; Page 40, Line 29: "condition flages"; Page 49, Line 23: "stock initiallization"; Page 252, Line 1: "Signals & Funcotins". More serious errors are discussed later.

The book opens with a brief outline of the evolution of microprocessors (Chapter 1) and then moves on to a detailed discussion of INTEL 8085 processor (Chapter 2). The author describes the architecture, instruction set, machine and instruction cycles, state transitions,etc. All the relevant and important features of 8085 are introduced in a simple and direct way. However, some printing mistakes could puzzle the reader for some time For example, on page 38, PC value is shown as 1000 before and after executing the instruction ORI 55, whereas it should be 1002 after executing this instruction.

The author now introduces the general concepts of number systems, binary systems and binary arithmetic in Chapter 3. This chapter includes many useful algorithms (multiplication, division, etc.) and all of them are presented in a lucid manner.

Chapter 4, the second largest one (50 pages) in the book, is devoted to software development. The author discusses, in fair amount of detail, the concepts of assembly language programming, algorithm development, etc. He introduces the control structures useful for structured programming and illustrates them (SEQUENCE, IF-THEN-ELSE, DO WHILE, DO UNTIL and SELECTION) with suitable program fragments. The author discusses not only the uses of assemblers but also their internal structure. Many programming examples are provided in this chapter to explain the different programming concepts. This chapter should make it easy for anyone to understand the basic principles of assembly language programming. However, a beginner using the programs as they appear in the text, is in for a rude shock. Most of the programs will fail to get assembled properly, or worse, they will get assembled properly but will produce erroneous results when executed. Representative cases are listed below:

a) The program on page 108 (illustrating the DO-UNTIL structure) has INX C, where it should have been either INR C or INX B. Further, it fails to initialize the register C used as a counter!

b) The program in the very next section, on page 109, also has an error. The comment in the third line of the program reads "multiply by 16 by 4 left shifts"; but the program has five RAL instructions!

c) The program on page 119, initializes HL register pair to OOOBH (supposed to be the address of TABLE) while it should be initialized to OOOCH.

d) Example 4.9, on page 120, states "The string is terminated by a full stop character (ASCII 2A in hex)". But ASCII 2AH represents a "*" and not a full stop character! The ASCII code for a period is 2EH. The same occurs in the next program on page 121.

This chapter has many such errors. It is tempting to brush aside these errors as mere printing mistakes but that will not help the unwary beginner using the book to learn programming. The reviewer sincerely hopes that the next edition will be free from such errors and thus will be truly of great value to the students. A discussion of common programming errors would also enhance the usefulness of this chapter.

Chapter 5 is devoted to hardware design. It introduces the concept of a bus, discusses bus loading and bus-based designs. Address decoding and data bus interface are also discussed. This chapter would have been more useful if devices like 6116, 6264 were discussed rather than the outdated 2114 devices. This chapter includes a detailed discussion of the facilities offered by Monitor programs. The general structure of a monitor program is also presented. This information should be particularly useful for beginners working with system design kits. One important aspect, missing both in the flow chart (pages 144 and 145) and in the text, is regarding error processing. Any good monitor program should be "robust" and handle error conditions in a graceful manner and a discussion of this topic would certainly enhance the value of this chapter.

Chapter 6 describes the building block approach to constructing microprocessor systems. It describes system design kits, single board computers and related boards and total packaged system. This is followed by a rather brief outline of operating systems and text editors.

Chapter 7 is devoted to describing a large variety of I/O devices like keyboards, displays, A/D converters, etc., in about 40 pages! The material is mostly descriptive in nature. Thus the reader can get an overall perspective but to actually use these devices, he/she has to consult other references for many implementation details. The description of general controller classes and common features is well presented. The author has thoughtfully included a discussion of RS 232 C standard also.

Chapter 8 discusses a variety of debugging and development tools for software, hardware and for integrating software and hardware. Debug monitors, PROM programmers, microcomputer development systems, logic analyzers, in-circuit emulators, etc., are discussed in this chapter. Information regarding so many tools is rarely available at one place and hence many readers would find this chapter extremely useful. Though only 25 pages are devoted to this informative chapter, the details provided will certainly help the reader to get a sound perspective and then he/she can consult the references listed at the end of this chapter to get more details.

In Chapter 9, the author introduces many support chips like 8755, 8155, 8255, 8251A and 8253. He discusses their functions, programming methods and potential applications. This chapter, the largest one in the book (65 pages), includes two practical design examples, presented in great detail. A good understanding of the material of this chapter should help a designer in "implementing many functions quite easily". However, apart from many printing errors, this chapter has one serious logical error. The block diagram of 8156A, on page 251, shows an 8-bit wide Port C and the design of digital 12-hour clock makes the same assumption. Thus the figure on page 285, shows the hours display as being driven by Port C of 8156A. But port C of 8156A is only 6-bit wide! The digital 12-hour clock cannot be realized the way it is presented!! But for this blemish, this chapter is a well-written and useful one.

The book closes with two appendices introducing 16-bit microprocessors (8086, Z8000 and 68000) and single-chip microcomputers (8051 and Z80). The author's intention of presenting this material "to round off the discussion on ... the 8-bit processors" is just served by these brief appendices.

On the whole this book presents a wealth of useful material and priced at Rs. 45 is definitely a good bargain.

Electro Systems Associates Pvt. Ltd. K. RAJANIKANTH
Bangalore 560 010.

Published by T K S Iyengar, Executive Editor, Journal of the Indian Institute of Science, Bangalore 560 012
Typeset and printed at Phoenix Printing Company Pvt Ltd Attibele Indl Area, Bangalore 562 107