J. Indian Inst. Sci., Sept.–Dec. 2003, **83**, 143–154
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Book Reviews

Spaceflight mechanics 2002, Volume 112 (Parts I and II) of Advances in the Astronautical Sciences edited by Kyle T. Alfriend, Beny Neta, Kim Luu and Cheryl A. Hilton Walkers, published by Univelt Inc., San Diego, California, USA, for the American Astronautical Society, 2002, pp. 1552, $ 330.

The two volumes record the proceedings of the twelfth Annual Space Flight Mechanics Meeting held at San Antonio, Texas, USA, during January 27–30, 2002, under the co-sponsorship of the American Astronautical Society (AAS) and the American Institute of Aeronautics and Astronautics (AIAA). A total of 100 papers were presented by researchers from the US and seven other countries, including 34 students, in 18 sessions. These included two special sessions on 'tensegrity structures' and 'future use of NASA's deep space network'.

The first session of the conference and the corresponding section of the proceedings is devoted to attitude determination and the sensors used for the purpose, which are very important aspects of flight mechanics in space. In particular, star trackers, being the most accurate instruments for attitude determination, receive immediate attention. The first paper of the session (and the volume) comes from a nascent space power, and is based on research at the Korea Aerospace Research Institute (KARI) towards precise attitude determination of the Korea Multipurpose Satellite-2 (KOMPSAT-2). Detailed algorithms for precise attitude determination are suggested including star catalog design, star pattern identification, and attitude estimation. Although star-cluster-based attitude determination and control has been in use for quite sometime, including in the Indian space programme, the paper presents some details of formulation and validation that may not be readily found elsewhere in the literature.

The second paper of the session/section describes a novel split-field-of-view star tracker being developed for the EO-3 GIFTS mission. The camera, designed to be autonomously self-calibrating, is capable of rapid and reliable solution of the lost-in-space problem as well as recursive attitude estimation. Two efficient Kalman filter algorithms for attitude, camera principal point offset, and focal length estimation are presented which make use of three-axis gyros for the rate data and star camera split field-of-view line-of-sight vector measurements. Both algorithms produce precise attitude estimates, but the second one scores higher in terms of reliability and robustness. The next paper, by the same group, discusses autonomous on-orbit calibration approaches for star tracker cameras for the same mission.

Star trackers provide the most accurate method of spacecraft attitude sensing. Telescopic star images are generally not pinpointed, and to obtain the best accuracy from the tracker, it is necessary to locate the centroid of the image centre in the CCD image. *Ab initio* centroiding is time-taking and processing-intensive. An interesting paper in the session proposes a method for predicting the approximate location of the stars in successive image frames using the satellite angular velocity as sensed by the rate gyro. The accurate centroid position is then obtained as an update on the predicted position by local image processing. To make the method fail-safe, when the rate gyro data are not available, the angular velocity is estimated using the kinematic equation and successive attitude estimates from the lost-in-space algorithm. Handling of noncircular star images is also discussed.

For spacecraft not equipped with gyros, the single-point attitude determination solution is non-unique in the absence of sufficient number of measurement vectors. Methods such as the windowed quaternion estimator are useful, but require the angular rate information. A rate estimator is proposed by researchers from Seoul National University which blends two different methods based on satellite kinematics and dynamics.

The inertial measurement unit (IMU) used in inertial navigation systems (INSs) is rather complex and expensive. In the last paper of the session, a novel concept for simplifying the IMU is proposed by Cho *et al.* which uses magnetic levitation principle to replace one single-axis rate or position gyroscope and one single-axis accelerometer concurrently with a simple structure.

In view of the importance of orbital mechanics in spaceflight, the main theme of the Meeting, four sessions are devoted to the subject. The first of these sessions recorded five papers, starting with an interesting study of stability bounds for three-dimensional motion close to asteroids. This is a topic of high practical value at present because of the numerous spacecraft missions to orbit and land on asteroids and comets, the most famous of which is the recently concluded NEAR mission to the asteroid Eros. Another paper in the session presents an analytical formulation of fast flyby trajectories around a triaxial body, a representation often used for asteroids.

Three papers in the session deal with earth satellite orbits. One of these reports, a generalised Sundman transformation for propagation of high-eccentricity elliptical orbits, which accelerates the numerical computation of high-eccentricity orbits and enables the simultaneous surveillance of thousands of orbiting bodies. Another, from Spain, explores the existence of almost-periodic orbits around the geostationary points, and finds initial conditions which would avoid frequent station-keeping manoeuvres. The third paper deals with orbit transfers to lower orbits using aerobraking, and proposes a strategy to minimise propellant consumption. The session also has a paper on the basic aspects of variations, potentials, and numerical integration in the context of oblate spheroids which form the basis of planetary and stellar shapes.

The session Orbital Mechanics II also has three papers on satellite orbits: satellite ephemeris representation using hybrid compression, precise onboard ephemeris propagation method using Clohessy–Wiltshire frame and multiple compressions, and a preliminary analysis of the SAC-C orbit reconstruction using the experimental GPS/GLONASS receiver Lagrange. It also has three papers reporting the ongoing activities in different organisations: a progress report on US Space Command astrodynamic standards effort, recent developments of the Raven Small Telescope Program, and astrodynamic research with the Air Force Maui Optical and Supercomputing Site. The remaining paper of the session reports on the Atmospheric Neutral Density Experiment (ANDE), a mission proposed to monitor the thermospheric neutral density at an altitude of 400 km. The primary objective of the mission is to provide total neutral density along the orbit of a spacecraft, which would help in improved orbit determination of resident space objects. The mission will also serve as a test platform for a new space-to-ground optical communication system, besides performing a number of other test/validation roles.

The third session on orbital mechanics also has three papers devoted to satellite orbits: orbit design and station-keeping strategy of the co-located geostationary orbits, an algorithm for autonomous longitude and eccentricity control for geostationary spacecraft, and optimal transfer between circular and hyperbolic orbits using analytical maximum thrust arcs. A fourth paper in the session proposes an autonomous landing manoeuvre by a landmark tracking technique based on a vision system. The aim is to achieve autonomous guidance of space probes during close approach to celestial bodies by reconstructing the motion of the spacecraft from the information gathered by a single CCD camera. The technique has the potential to provide enough information about obstacle position and dimension, time to impact, and the relative motion transversal to the line of sight with a meaningful reduction in computational time and cost over classical approaches. The only other paper of the session postulates an efficient searching strategy based on the capabilities of a single ground station. The study is conducted in the context of the Italian satellite MITA, with the aim of verifying if a single ground station can locate a space vehicle through a suitable search strategy around its normal orbital waiting point.

The fourth and the last session on Orbital Mechanics also has five papers, starting with one on the design of earth return orbits for the Wind mission, NASA's interplanetary physics laboratory, utilising repeated lunar gravity-assist flybys. The second paper studies the orbital perturbation environment for the COBRA and COBRA elliptical teardrop constellations. These are interesting orbits proposed as alternatives to the geostationary belt which is getting saturated with the existing satellites. The third paper reports on an interesting method for the calculation of the probability of a laser beam illuminating a space object which accounts for position, velocity and error covariance matrices of the laser emitter and the space object. Laser slew rate, pointing uncertainty, beam divergence half cone angle as well as space object size and shape are also included in the study. The next paper of the session also deals with direct laser impingement on satellites, presenting several methods for assessing the instantaneous risk of such impingement. The last paper of Orbital Mechanics IV session dwells on the topic of orbit and attitude manoeuvres using single offset axial thruster.

Space is no more the lonely expanse it originally was. Certain zones of space, notably the low-earth and geostationary belts, are now populated with spacecraft, objects, and debris at a density that poses a distinct hazard to fresh launches. This calls for observing/tracking of pre-existing space objects, meddling the debris environment, spacecraft hardening for minimising damage, and evolving orbits and strategies for debris evasion. An entire session is devoted to this issue. As many as five papers of the session deal with debris modelling and collision analysis in different belts and using varying approaches. The sixth paper reports an analytic solution for collision avoidance (COLA) manoeuvre optimisation for near-circular orbits.

Attitude control and determination is an indispensable session in any meeting on spacecraft mechanics. The session at this Meeting has papers on the design of the reaction wheel attitude control system for the Cassini spacecraft, use of guidance and control test cases to verify spacecraft attitude control system design, attitude control of earth-pointing spacecraft using reaction jets and magnetic torquers, global adaptive stabilisation using output feedback for spacecraft attitude tracking, and ICESAT/GLAS laser-pointing determination.

The activity level in the interplanetary missions scene has resulted in two sessions being devoted to the subject. Expectedly, based on the ongoing missions, Mars and minor planets/comets are accorded prominence as destinations. In the first session, there are four Mars-related papers dealing respectively with a low-cost and low-technology mission concept, celestial navigation on the planet's surface, optical navigation for the Mars Premier 2007 orbiter approach phase, and the effect of ultra-stable oscillator stability on one-way Doppler navigation of the planet's reconnaissance orbiter. Besides these, the session has a paper on low-thrust orbit transfer around minor planets, a gravity model for navigation close to asteroids and comets, and navigation of aerial platforms on Titan, the largest satellite of Saturn (and the largest of planetary satellites in the solar system).

The second session on interplanetary missions places emphasis on trajectories to Jupiter, consistent with the number and diversity of ongoing missions to the planet. It opens with a paper on the orbit reconstruction of Cassini from earth flyby (December 30, 2000) to Jupiter flyby, with emphasis on orbit modelling and the resulting solution. The Cassini mission's aim was to study Saturn and its satellites, rings, and magnetosphere. It deployed a fuel-efficient trajectory by employed gravity assistance from two Venus flybys, an earth flyby, and a Jupiter flyby before injection into its orbit around Saturn, due on July 1, 2004. Formal fitted uncertainties have yielded a B-plane uncertainty ellipse with semi-major and semi-minor axes of 115 and 0.6 km, respectively. The one-sigma uncertainty at the time of closest approach has been estimated to be 0.08 s.

The next paper of the session also deals with a Jupiter encounter orbit reconstruction, but with reference to Pioneer and Voyager missions. This is followed by a paper 'Ballistic Jupiter gravity assist, Perihilion-DeltaV trajectories for a realistic interstellar explorer' focusing on a conceptual 'interstellar precursor mission' designed to achieve velocities capable of carrying a spacecraft to penetrate the nearby stellar medium (of the order of 1000 Astronomical Units) within a human's working lifetime (~ 50 years). The orbit is postulated to derive gravity assist from Jupiter, subsequently making a high-specific-impulse, high-thrust manoeuvre near the sun.

Another conceptual paper deals with the computation of minimum-propellant earth-capture trajectories using solar-electric propulsion, which has become a viable option following the success of the Deep Space 1 mission. This paper is followed by one on hyperbolic rendezvous for earth–Mars cycler missions. The session has an instrument-related paper on the precise determination of accelerometer proof mass.

Two sessions of the Meeting are devoted to formation flying wherein two or more spacecraft are flown in precise relationship with each other to achieve specific objectives such as coordinated observation. The first such session has three papers on the characterisation of formation-flying satellite relative motion orbits, a solution of the elliptic rendezvous problem with the time as an independence variable, and a third-order analytical solution for relative motion with a circular reference orbit. The second session has six papers, covering the accommodation of nonlinearity and eccentricity perturbations, long-duration analysis of the J2-model equations of relative motion for satellite clusters, the state transition matrix for relative motion of formation-flying satellites, steering law of satellite formation flight using solar radiation pressure, application of several control techniques for the ionospheric observation nanosatellite formation, and the dynamics of formation flight about a stable trajectory.

A related topic, that of tether satellite systems, also forms the subject of a session. These are satellite pairs or clusters strung together by a flexible or semi-flexible member. The first paper in this session reports on the dynamical study of a possible multitether system (MTS), i.e. satellite formations linked by a system of tethers held taut by the rotation of the entire system. The subsequent papers deal with the effect of distributed rod and string flexibility on the dynamic stability of formations, dynamic stability of a bare tether as a deorbiting device, orbital manoeuvring with electrodynamic tethers, and an overview of the tethered artificial gravity satellite program.

A session on optimisation and control dwells on topics such as direct multiphase optimisation of multiobjective trajectory design, stability issues using FIR filtering in repetitive control, frequency domain prediction of final error due to noise in learning and repetitive control, application of the SDC optimal control algorithm to low-thrust escape and capture trajectory optimisation, and the use of root locus departure angle information to design compensators in repetitive control.

The first of the two special sessions of the Meeting was a brief one with three papers devoted to the new class of Tensegrity structures, which are prestressable stable dynamical truss-like systems made of axially loaded elements. These structures pose a potent blend of geometry and mechanics, and have engineering appeal in problems requiring large changes in structural shape. The papers here discuss the equilibrium conditions of a Class I Tensegrity structure, decentralised control of stable-element Tensegrity plates, and equilibria and stiffness of planar Tensegrity structures.

The second special session, which is the last session of the Meeting, is devoted to charting out the current and future use of NASA's deep space network (DSN), which is the most extensive, sensitive, and capable such network in the world. Its multiple elements (especially the communication and tracking systems) are subject to heavy and uncoordinated demand for utilisation from a host of diverse laboratories and institutions within NASA and outside it (e.g. from university groups and defence departments). Allocation and scheduling of such demands is a very complex task, and must be handled scientifically. The first three papers dwell on the RAPSO (resource allocation planning and scheduling office) process of the Jet Propulsion Laboratory, presenting aspects of the process itself, allocating the DSN view periods, and long-range usage/allocation forecasting issues. The fourth and last paper touches upon an important issue: that of designing missions themselves and preparing proposals taking into account DSN schedules and availability.

The Annual Space Flight Mechanics Meeting is an event that the global space community, and not just those involved only with space flight mechanics, eagerly looks forward to. Over the years it has formed a forum for intense interchange of awareness, information, knowledge, and expertise in many aspects of space science. However, there are less fortunate professionals, especially from far-out locations such as ours, who do not have the privilege of attending the Meeting personally. For such scientists, these volumes capturing the proceedings offer a gold mine of information.

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Reinforced concrete design by N. Krishna Raju and R. N. Pranesh, New Age International Pvt Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002, India, 2003, pp. 612, Rs 250.

The philosophy of design of reinforced concrete members is based on two-material concept of different modulii of elasticity. Relying on the linear relationship of stress–strain variation adopted for reinforced concrete structural members, the choice for the analysis and design normally falls on Working stress method. This method for, obvious reason, is also known as the Modular ratio method.

Though this method is very popular and is capable of predicting stress condition at service load, which is not sufficient to cause the yield of the constituent materials, it cannot predict the stress condition at much higher loads owing to the very nonlinear behaviour of the materials of the structural member. Moreover, if at any typical location the stress attains its maximum allowable value, the entire structure is declared as unsafe, even though elsewhere in the said section, or elsewhere in other sections of the structure, the stress may still be less than the permissible one, and the structure may still be capable of withstanding much higher load before collapse. Nevertheless, the true factor of safety against failure is difficult to assess. Thus, a great margin of safety against collapse in the Modular ratio method demands a better design method with a view to utilise the material properties more economically.

In the Ultimate strength theory method, inelastic behaviour of the materials like steel and concrete can be taken care of. Using the concept of load factor as the ratio of the collapse to working load, the procedure (such as Modified load factor method), works on the ultimate load principles in design, but in the calculation, the working stress concept is retained. The variation of concrete strength being abrupt compared to that of steel, additional use of factor of safety can be accounted for by concrete mixes. This method, on the other hand, is useful in assessing the ultimate load of the structure and cannot be utilised to predict the response at the service load.

The structural member may have to withstand different aggressive and deteriorating influences which may affect the strength as well as durability of the structure inviting damage, cracks, excessive deflection and the like. All these effects, individually or collectively, cause early collapse which effectively is related to age and longevity. In fact, a designed structure should resist all these deteriorating effects and would ensure a longer safe life. The earlier two widely used methods do not have any room to incorporate these aspects.

The concept of Limited state method was introduced with a view to include some such influential aspects in a more practical way as a loaded structure is often to face and to remain safe under all limit states of strength and serviceability. For reinforced concrete structures, the expected life span may be taken anywhere between 100 and 120 years.

The Limit state method is a more reliable method since it is developed on the basis of statistical probability of loads and materials. In day-to-day practice, Limit state of collapse and Limit state of serviceability safeguard the maximum loading capacity, and deflection and crack width, respectively, and are in wide use for practical design. Hence it is a more realistic method.

In this book, the author presents the reinforced concrete design of different types of structural members like beams (singly and doubly reinforced sections) in flexure, shear and torsion in sufficient detail in step-by-step manner so that one can easily follow the underlying procedure with ease. Slabs, stairs and foundations (pile and raft) have been treated in a similar manner. Additionally, traditional working stress method as well as principles of earthquake-resistant design conforming to the respective codal requirements have been included. The design examples have been dealt with considering ultimate strength as well as serviceability requirements. Latest IS code 456:2000 has been followed for design. Along side, SP:16 design tables have been used wherever found necessary.

The get-up and the type used are commendable. The illustrations are meticulously planned and are presented with appropriate standard prototype structures as encountered often in practical situations. The associated drawings/figures are equally clear, distinct and suitably arranged. This is an asset of this book. The reader is tempted to go through the subject matter in depth.

The book contains topics which cover the curriculum of technical institutions, NITs, IITs and other Indian universities. It will cater to the need of undergraduates as well as the practicing engineers working in field projects. The authors have taken utmost caution to restrict each topic to optimum length without missing the important steps. The historical development has been covered in the introductory note and could have been slightly more descriptive. The same is true with the comparative merits and demerits of the three methods, viz. Modular ratio method, Load factor method and Limit state method to justify the versatility of the Limit state method based on which the present book is written.

The book incorporates the most recent codal requirements and will fulfill the need of the hour.

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Power electronics and its applications by Alok Jain, Penram International Publishing (India) Pvt Ltd, Mumbai 400 015, 2002, pp. 424, Rs 195.

The book under review is addressed to undergraduate and polytechnic students who are interested in power electronics. It contains nine chapters, namely, 1. Review, 2. Power semiconductor devices, 3. Firing commutating and protecting circuits, 4. Uncontrolled rectifiers, 5. Controlled rectifiers, 6. Inverters, 7. Choppers, 8. AC voltage controllers and cycloconverters, and 9. Applications of power electronics.

While the review chapter is intended to recollect some of the material that might have been studied in earlier courses, the coverage of power electronics starts with the second chapter on power semiconductor devices. The basic operating principle and the terminal characteristics of various devices are described. The treatment is adequate to acquaint the reader with the different devices available and seems to conform to the syllabus of many Indian universities.

Circuit aspects are treated in Chapters 4–8. The material on controlled and uncontrolled rectifiers is fairly broad in coverage. But as with many other texts, there is some preoccupation with R–L loads, discontinuous conduction, solution of the load differential equation to calculate extinction angle, etc. While these topics may serve to set problems for the examination, they do not give the student much insight into the various circuit configurations. It is much better to assume continuous conduction in the load and emphasize the behaviour of different circuits in terms of transformer utilization, power factor, voltage and current rating, etc.

The chapters on inverters and choppers again devote too much time to outdated topics such as commutation. With the availability of modern devices such as IGBT, it is better to assume ideal switches and emphasize the effect on the load. It would have been more to the point to discuss gate drive, protection, snubbers, resonant switching, etc. in the context of inverters.

The material on AC voltage controllers in Chapter 8 again lays too much emphasis on tedious analysis. To treat cycloconverters with R–L loads is again pointless. It would have been more instructive to assume continuous sine wave currents in the load and emphasize the conduction patterns of the converters. The chapter on applications is obviously intended to help the student with ‘Short notes’ questions. The coverage is very sketchy.

In summary, the book can be used in an introductory course on power electronics at the undergraduate level. The student would however have to supplement the contents by reading well-known texts (many of which are given as references).

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Wavelets and signal processing edited by Lokenath Debnath, Birkhauser Verlag AG, Klösterberg 23, CH 4010 Basel, Switzerland, 2003, pp. 464, chF. 144.

Over the last two decades, extensive research has been carried out by mathematicians, physicists and engineering scientists on the theory and applications of wavelets. Applications cover a wide variety of fields such as signal and image processing, computer graphics, computer vision, pattern recognition, medical imaging, etc. The editor of this volume has performed a commendable job by compiling a set of articles, a majority of which can be branded as excellent, into a single volume, which includes state-of-the-art theoretical results as well as some applications. The book will be useful for researchers as well as practicing professionals, not only because of its contents, but also because of the fact that it provides directions for future developments.

The contents are divided into two parts. Part I, comprising Chapters 1 to 5 deal with wavelets and wavelet transforms, while Part II, comprising Chapters 6 to 13, deal with signal processing and time-frequency (TF) signal analysis.

In the opening chapter, (Leon) Cohen presents a general method for calculating relevant moments of the wavelet transform, and gives explicit results for the time, frequency and scale moments. The unique characteristics of wavelets, which are not possessed by other competing methods are highlighted, along with their physical and mathematical importance. The chapter ends with some exactly solvable problems, using the Morlet wavelet and its modified form.

In Chapter 2, Cabrelli, Heil and Molter apply the idea of self-similarity to wavelet theory, so that wavelets associated with a multiresolution analysis of R^n allow arbitrary dilation matrices with no restriction on the number of scaling functions.

Chapter 3, by Lakey and Pereyra, demonstrates the nonexistence of biorthogonal pairs of divergence-free multiwavelet families on R^n, having any regularity such that both families have compactly supported, divergence-free generators. The main result of the paper generalizes Lamarie's bivariate result, based on vector-valued multiresolution analysis.

Battle deals with Osiris wavelets and Isis variables in the next chapter. While modelling based on Osiris wavelets has important advantages over other familiar hierarchical approximations, the paper focuses on the kinematic coupling of the wavelet amplitudes that arise for these models. The variables associated with different length scales are no longer independent with respect to the massless Gaussian, thus creating spurious Gaussian fixed points, in addition to the usual well-defined one, which influence the flow of iteration. A recursion formula and its linearization are presented for dipole perturbation of the Gaussian fixed point.

Chapter 5, by Chandramouli and Ramachandran, presents statistical application of wavelets in signal estimation and detection. A new signal estimator is introduced that attempts to estimate and preserve some moments of underlying original signal. The relationship between signal estimation and data compression is discussed. For signal detection, a likelihood ratio-based wavelet level-independent hypothesis test is investigated. First, hypothesis tests are performed at each level of the wavelet decomposition, and then a global fusion test is performed to combine these individual decisions into a global one.

Part II opens in Chapter 6 with a paper by Boashash and Sucic on the key concepts and techniques needed to design and use high-performance time-frequency distributions (TFD). First, the core concepts of TF signal processing, including recent developments, such as the design of high-resolution quadratic TFDs for multicomponent signal analysis, are introduced. This is followed by methods of assessment of the performance of TF techniques in terms of separating closely spaced components in the TF domain. Finally, a methodology is presented for selecting the optimal TFD for real-life signals.

In Chapter 7, Hlawatsch, Taubock and Twaroch present a theory of linear and bilinear/quadratic TF representations based on covariance principle. This theory establishes a unified framework for important classes of TF representations, yields a theoretical basis for TF analysis, and allows the systematic construction of covariant TF representations. The covariance principle is developed in group as well as TF domains and the properties and construction of the displacement function connecting these two domains are studied. Also introduced are important classes of operator families and the results of the covariance theory are applied to them.

Time-frequency/time-scale (TS) reassignment is the subject of discussion in Chapter 8 by Chassande-Mottin, Auger and Flandrin. The reassignment principle aims at sharpening TF and TS representations in order to improve their readability. It consists in moving the TF contributions from the point where they are computed to a more appropriate one. Efficient implementation and operation of the principle are discussed, with special reference to cases yielding closed-form expression. A geometrical characterization of the transform of the TF plane made by reassignment is given. Examples of signal denoising and detection are used to demonstrate the usefulness of reassignment in practical signal processing.

Amin, Zhang, Frazer and Lindsey present, in Chapter 9, a comprehensive treatment of the hybrid area of TFDs and array signal processing, and address important problems relating to the processing of nonstationary signals incident on multiantenna receivers. Advances made in the area of direction-of-arrival estimation, signal synthesis and nearfield source characterization through TF analysis are discussed.

Chapter 10 by Papandreou-Suppappola deals with TF processing of time-varying signals with nonlinear group delay. A tutorial presentation is provided on the classes of quadratic TF representations (QTFRs) which preserve constant and dispersive time shifts. The relationship between group delay shift covariant QTFR classes and the constant time-shift covariant ones is established. Examples are provided to demonstrate the importance of matching TF characteristics of the signal to the group delay shift of the QTFR. Benassi, (Serge) Cohen, Degney and Ista propose a class of stochastic processes having an extended self-similarity property and intermittency. The model is parameterized with a scaling factor and a measure of intermittency, and statistical estimates for both are presented, along with a proof of their strong consistency. Some examples of simulation and estimation are included.

Selective thresholding in wavelet image compression forms the topic of Sansginy and Mihaila's presentation in Chapter 12. They explore nonuniform ways to threshold the compressed matrix of the image obtained via wavelet transforms.

Chapter 13 deals with a challenging problem in a completely different field, viz. fluid mechanics. The authors—Azzalini, Pellegrino and Zuiber—review a method called coherent vortex simulation (CVS) for extracting and computing coherent structures of turbulent flows. It uses orthogonal wavelet decomposition of the verticity field which can be highly compressed with wavelet filtering. Numerical simulations using CVS are performed for turbulent flows in two and three dimensions. A comparison of the results with those of direct numerical solution shows the promise of the CVS as an efficient method for simulation of turbulent flows at high Reynolds number.

The book, in my opinion, places heavy emphasis on mathematical aspects; applications are few and far between. But, perhaps, this is to be expected because of the background of the editor and his known circle of professional friends and researchers, some of whom were invited to write for the book. Also, some of the applications of wavelets discussed in the book are somewhat mundane. This introduces some amount of inhomogeneity in the articles. Inhomogeneity also arises due to the varying depths of treatment, somewhat evident from the varying lengths of the articles (5 to 58 pages). Finally, the beginner would be well advised to acquire some basic background before being able to use the book gainfully.

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An introduction to Fortran 90/95: Syntax and programming by Yogendra Prasad Joshi, Allied Publishers Pvt Ltd, P.O. Box No. 7203, 1/13–14, Asif Ali Road, New Delhi 110 002, India, 2003, pp. 501, Rs 240.

This book based on Fortran 90 (F90) standard includes, in addition to F90, Fortran 95 which is a minor revision of F90. The three main extensions with respect to F90 version are

- FORALL statement and construct,
- PURE and ELEMENTAL procedures,
- Structure and pointer default initialisation.

Pure Fortran 77 (F77) which is the 1977 standard of structured Fortran is F90-compatible and a subset of F90. F90 allows the F77 user to write code faster, to make it more legible, and to avoid many bugs. F90/95 provides an opportunity for a beginner programmer to learn a modern programming language with most recommended features, and yet be in line with science and engineering communities where Fortran is and will remain for a good while the *most popular language*. Over the past five decades, many programming languages have come and gone while Fortran starting its journey in the 1950s in an unstructured form underwent desirable changes, became structured, and survived well. Today it is the oldest and yet popular programming language mainly for scientific and engineering computations.

The main extensions of F90 over F77 are

- dynamic memory allocation (ALLOCATE, DEALLOCATE, . . .),
- free format source code form,
- array notation (A(1:M) = B(1:M)*SIN(C(1:M))),
- derived types and operator overloading,
- more of modern control structures (SELECT CASE, EXIT, . . .),
- better declarations and prototyping,

- MODULES permitting programmers to create storage pools,
- more of intrinsics (date, precision, arrays, . . .).

The book is ISO standard based and contains simple illustrative examples. It consists of 15 chapters and 7 appendices. Chapter 1 introduces the language while Chapters 2–4 embody the essential elements of the language. Chapters 5–14 comprise advanced features of F90 while Chapter 15 is an exposition of the features that are included in F95. The information embedded in the seven appendices assists in understanding the text better. The F90/95 seems to have withstood the onslaught of extensively used C programming language particularly in the realm of large-scale numerical scientific and engineering computation.

The book is intended for a wide variety of audiences, specifically those involved in solving a very large numerical problem, and who do not need an extensive knowledge in formal programming constructs. While MATLAB is possibly the most popular software allowing writing physically concise programs and is meant for not too large a problem, the F90/95, though generates relatively physically large programs and is more involved in its usage, has greater scope and flexibility for large complex problems. The book is certainly a useful addition to the other Indian publications.

Whenever we talk about a language, specifically a formal programming language, syntax and semantics are automatically stressed. Unless the ‘syntax’ is very specially stressed, there is possibly no need to include the word ‘syntax’ in the title. Compared to other books in this area, I do not see any speciality in the syntax that is well written and well explained in this book. I, therefore, feel that the two words, viz., ‘syntax’ and ‘and’ may be omitted from the title in the next edition. Even the word ‘An

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Printed and published by Dr S. Venkadesan, Executive Editor, *Journal of the Indian Institute of Science*, Bangalore 560 012; Printed at Ravi Graphics, Bangalore 560 044.