

## BOOK REVIEWS

**Ramanujan – Essays and Surveys.** Bruce B. Berndt and Robert A. Rankin (eds). Culture and History of Mathematics Series. Hindustan Book Agency (India), P 19 Green Park Extension, New Delhi 110 016. 2003. 347 pp. Price: Rs 450.

Our curiosity about the great is by no means confined to their lofty pursuits and achievements (perhaps because it is their common place experiences that will reassure us of our kinship with them). And in the case of Srinivasa Ramanujan, that curiosity is greater as the bare outlines of his life have so much of the romantic element. The excellent biography of Ramanujan by Robert Kanigel (one wishes that its title had been chosen more felicitously though), is indeed a comprehensive work; yet there remain many unanswered questions. The volume under review provides some facts of human interest not to be found in Kanigel's work and at the same time caters also to those who seek an introduction to the workshop of the genius. It is actually an Indian reprint of an American Mathematical Society publication. Happily, its affordable cost offsets the (marginal) superiority of the American publication in terms of production values.

The book is a collection of essays which for the most part have appeared in journals and conference proceedings, publications normally accessed only by mathematicians. There is, however, some interesting previously unpublished material. The editors, Bruce Berndt and R. A. Rankin, are well-known figures in the mathematical community, not the least for their Ramanujan-related mathematical (as well as other) contributions.

The book is divided into eight parts. Part I begins with a note on the only four extant photographs (all of which are reproduced) in which Ramanujan appears. Berndt has managed to date the photographs and to identify people other than Ramanujan in them. The next article by Berndt and Rankin is about the books that Ramanujan had studied and was influenced by before he went to Cambridge. The authors have examined carefully all available records to determine which books Ramanujan really had access to. There is a separate essay by Berndt on the influence of one particular book, *Carr's Synopsis* – it is not a particularly inspiring work, but Ramanujan has immortalized it.

*Ramanujan – The Notebooks* published in two volumes in 1957 by the Tata Institute of Fundamental Research, is a compilation of the photocopied pages of mathematical notes made by Ramanujan in some notebooks he maintained prior to his departure to England. A note by Berndt tells us that the original notebooks are to be found in the Librarian's office of the University of Madras, but have suffered some damage from insects, despite lamination. Luckily, photocopying for the 1957 volume was done prior to this damage. We owe the publications of *The Notebooks* to the initiative of K. Chandrasekharan, one of our leading mathematicians – a fact that unfortunately finds no mention in much of the extensive writings about Ramanujan. The impact of the Ramanujan story on young minds in his own student days is described by S. Chandrasekhar in a short piece. Part I ends with an article by Rankin, describing the contents of a notebook containing notings by Ramanujan's two brothers about family matters.

Ramanujan's illness is the subject matter of Part II. It contains an article of Rankin's which appeared in the *Proceedings of the Indian Academy of Sciences* and another by a physician, D. A. B. Young, who did some investigations on the subject for the Royal Society. These articles have considerable information not to be found in Kanigel's book. Among other things, it appears that the contemporary diagnosis of Ramanujan's illness was not satisfactory.

Part III has a short biography of Janaki, Ramanujan's wife. It is a tragic but not unfamiliar Indian story of a courageous woman widowed young in early 20th century – except that her husband was an extraordinary genius. An interview given by her to Pritish Nandy provides some glimpses of her personality. Narayana Iyer of the Madras Port Trust was perhaps the closest friend Ramanujan had in India. In Part IV, Berndt sketches a brief biography of Narayana Iyer. Also reproduced are two papers published by Narayana Iyer in which theorems due to Ramanujan are communicated. The English version of a talk by E. H. Neville 'broadcast in Hindustani in the Indian service on 22 April 1941' is reproduced in Part V. Neville was a British mathematician who met Ramanujan in 1914 in Madras, and played a significant role in Ramanujan's passage to Cambridge.

In Part VI, Rankin introduces the readers to *The Notebooks*, and other manuscripts providing historical information. This is followed by an overview of *The Notebooks* by Berndt and one on the *Lost Notebooks* by George Andrews (these are mathematical notes made by Ramanujan that lay unnoticed in Cambridge archives for almost half a century till Andrews brought them back to the attention of mathematicians. Photocopies of these notebooks were published by Narosa Publishing House in 1987; the two-volume book was released by the then Prime Minister, Rajiv Gandhi at the Centenary celebrations held in Chennai on 22 December 1987.

'Ramanujan and pi' is an interesting article on how some of Ramanujan's work impinges on computing the number pi (the ratio of the circumference to the diameter of a circle) to great degrees of accuracy. A. Selberg, one of the titans of 20th century mathematics, gives a fascinating account of the influence Ramanujan's work had on him in his formative years. This part (Part VII) also includes a collection of problems submitted by Ramanujan to the *Journal of the Indian Mathematical Society*, compiled by Berndt, Chow and Kang.

The last part has somewhat more technical articles; Dyson's article written in his inimitable style has, however, something to offer to the lay reader as well.

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**Auxiliary Signal Design for Failure Detection.** Stephen L. Campbell and Ramine Nikoukhah. Princeton Series in Applied Mathematics. Princeton University Press, 41 William Street, Princeton, New Jersey 08540. 2004. 202 pp. Price: US\$ 26.95.

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The book has dealt with a topic which is important in control system design, namely failure detection and identification. Failure detection has been dealt in the past using passive approaches, where certain parameters/signals are monitored

on a continuous basis and deviations from prescribed limits of these parameters are used to record the failure of a system's performance. This approach is a popular one and exists in many working systems. The other approach is called the active approach, where, an auxiliary signal is injected into a working system and a separate detection sub-system analyses the signals of the system, enabling detection and identification of the failure. The active approach is, in a way, intrusive and can affect the dynamics of the system if the input is not carefully designed. The design of auxiliary signals, therefore, is an important aspect of the active approach of failure detection and identification in a control system.

This book deals with the optimal design of auxiliary signals for dynamical systems characterized, in general, by linear state-space models. The approach used in the book is different compared to previous literature dealing with this aspect. The book presents a systematic development of the analytical framework for auxiliary signal design, based on properties of subspaces of matrices of the state-space model.

Chapter 2 presents a clear and lucid introduction to the proposed framework of analysis for failure detection. A model is assumed for the normal working and any deviation implies occurrence of failure. The idea is to take the input and output signals and form a function which determines if the functioning of the system is 'normal' or not. This implies that the input signal needs to be 'designed' properly which would indicate failure. The framework for detecting a single failure has been developed systematically, starting from the static case and extending it to the dynamic case, with examples illustrating the methodology of design. The results presented are based on properties of matrices, with emphasis on subspace interpretation. The auxiliary signal design is formulated as an optimization problem involving the famous Riccati equation related to the state-space model. An important aspect of signal design is the real-time implementation of such methods. A section on the real-time issues is presented. The highlight of the approach presented is that it is different, novel and powerful in the analytical sense. The connection with existing work is clearly shown and emphasis is put on failure detection based on short time intervals.

Chapter 3 extends the results of the previous chapter when multiple failures are to be detected, using a multimodel approach. The highlight is the ease of extension of the framework in the previous chapter to a generalized framework. The additional constraints imposed translate into new results on signal design. A useful example illustrating the methodology is presented for the case of a vehicle suspension system design.

Chapter 4 presents the framework of signal design as a direct optimization problem. This approach is interesting and presents useful insights in terms of the trajectories of dynamical systems. The issues of numerical computation for the solutions are presented with respect to the authors' experience with packages like SOCS.

Chapter 5 summarizes the possible extensions of the proposed framework to new problems, highlighting the versatility of the framework. Sample programs using Scilab are also available for the readers to experiment.

This book is a research monograph focusing on a niche topic, written by leading researchers in the fields. The reader needs a good background of state-space modelling of dynamical systems and matrix algebra. The monograph is useful for researchers in this field and also system designers, who can benefit from the new approach to signal design, leading to good system design. The book has been written well and is almost free from spelling and grammatical errors, but for a rare error on page 15, where the word 'consistent' is used instead of 'consist'.

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**Calcium Channel Blockers.** T. Godfraind (ed.); with a contribution by Eric Ertel. Milestones in Drug Therapy Series. Birkhauser Verlag, P.O. Box 133, CH-4010, Basel, Switzerland. 2004. 262 pp. Price not mentioned.

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Ion channels are ion-specific holes in biological membranes with complex architecture. They are regulated by changes

in membrane electric field and ligands. Their importance in cellular physiology is being realized at an alarming pace. Understanding the pharmacology of ion channels is also becoming important, since by modulating their activity one can affect cellular function, and thereby regulate the function of complex tissues like the heart and the brain. Diseased conditions due to ion-channel malfunction are now classified under channelopathies.

There are not many books that are entirely devoted to ion-channel pharmacology. The more recent ones are *Molecular Physiology and Pharmacology of Cardiac Ion Channels and Transporters* by Morad *et al.*, published by Kluwer Academic Publishers (1996) and *Ion Channel Pharmacology* by Bernat Soria and Valentin Cena, published by Oxford University Press (1998). Part of the reason could be that in the last few decades more research attention has been paid to the discovery of ion-channel subtypes and splice variants of ion channels. In comparison, discovery of new molecules that modulate the ion-channel targets has been lagging behind. Combinatorial chemistry has become an important tool for discovery of new lead small organic molecules. This is now paralleled by developments in high throughput screening assays for ion-channel activity.

Among the different ion-channel types, a class of ion channels called the voltage-gated calcium channels are of immense pharmacological interest since they are found in tissues such as the heart, blood vessels, pancreas and the brain. They gate the entry of calcium inside the cell, which acts as an important second messenger regulating important functions like the contraction of individual myocytes, whose coordinated contractile activity translates into a heart beat. It is also noteworthy that although Ringer suggested the biological importance of calcium in 1883, research into the pharmacology of calcium began only forty years ago.

Godfraind, the author of this book, has been one of the key contributors to calcium pharmacology research. In the 1960s, Godfraind and co-workers demonstrated that inhibition of Ca entry into arterial tissue causes vasodilation. This book is a compendium of research on calcium-channel blockers, and their pharmacological actions on the cardiovascular system, significantly based on the results