Book Review

Space safety and rescue 1997

edited by Gloria W. Heath, Science and Technology Series, Volume 96, Published by Univelt, Inc., P. O. Box 28130, San Diego, California 92128, for the American Astronautical Society, 1999, xii + 400, $80.

The papers in this volume constitute the proceedings of the 30th International Symposium on Space Safety and Rescue, held at Turin, Italy, in October 1997. The papers in the volume are categorized under several sections.
The first section entitled New concepts in safety, rescues and quality in space programs has a collection of papers on safety issues that arise in various space programs. The paper by Kompaniets and Shatrov is a Russian contribution that addresses the problem of ensuring riskfree routes for launch vehicles and selection of impact areas for separating parts of the launch vehicle by determining the probability of these objects impacting a given area. Statistical data from about 500 launches forms the mainstay of the paper. The next paper by Vongsouthy et al. discusses the challenges, in terms of crew safety, inherent in the task of carrying complex payloads and cargo and involving diverse international participants in America s manned space flight program. The paper by Seastrom et al. is a joint paper by American and Russian scientists addressing risk management in international manned space programs like the Shuttle/Mir program. The last paper by Grimard is a thought-provoking introductory address to the round table discussion on the challenges of maintaining quality and safety in space programs under reduced budgetary constraints.

The section on Risk assessment and management has a collection of papers on various topics related to risk. These papers cover the topics of developing metrics for software risk assessment (Lee and Loftus), risk assessment in the design process of micro-satellites (Santoni), control of coupled risks in mission management (Wimmer), risk assessment methodology (Ferrante et al.), on using risk as a resource in the sense of trading it to obtain faster and cheaper designs (Greenfield), and a discussion on insurance issues in European space programs (Thiebaut).

The next three sections are all related to various aspects of space debris. The first of these is on Space debris measurements and modeling and contains papers on the state of orbital debris measurement and modeling in the world (Johnson), coolant leak from satellites as a source of orbital debris (Kessler et al.), optical measurement of space debris in GEO (Schildknecht and Hugentobler), optical characteristics of Ariane IV (Maley), measurements of meteoroids and space debris (Drolshagen et al.), and finally, creating space debris environment models from measurement data (Jehn and Klinkrad).

The section on Space debris: risk analysis and mitigation implementation has papers on assessment of pre-flight risk and post-flight damage caused to space shuttles due to space debris (Levin et al.), overview of the space debris environment and some methods to manage this hazard (Jensen et al.), collision risk assessment based on fragmentation models for uncatalogued debris (Jehn), the prediction of collision possibilities between objects in space carried out in

France (Alby and Mesnard), the possibility of increase in space debris population due to satellite collisions and mitigation measures (Walker et al.), effect of debris caused by coolant leakage from some nuclear powered Russian satellites (Rossi et al.), reentry of large debris from space- BOOK REVIEWS 512 Tholasi Prints Mar Apr. Issue Received on No. Pgs. 9 1st proof Date: 17/10/02 SP (Book Review. p65) craft and launch vehicle upper stages (Johnson), and finally a fascinating paper by Dubois on the havoc that a wandering asteroid impacting with earth can cause and some ways to prevent an occurrence like this that may very well spell the doom of human race just as it had that of dinosaurs 65 million years ago.

The section on Space debris mitigation and space system design has papers on the necessity of implementing space debris mitigation measures (Rex), the various techniques of disposal of upper stage motors so that they do not add to the space debris population (Reynolds et al.), the type of evasive maneuvers required by space shuttles to avoid collisions with space debris (Loftus et al.), the different methods to protect the international space station from orbital debris (Gleghorn), a model that considers the large telecommunications satellite population as a different class of potential collision objects from the standard debris population (Mendell et al.), and finally design of a speculative laser device that can destroy orbital debris from the surface of the earth (Bekey).

As usual, the papers are of a fairly high standard and the fact that they have been written by people who actually work on the space debris and space safety aspects on a practical day-to-day basis adds strength to the ideas and issues discussed in these papers. These papers and not only those in this volume but also in other volumes in this series present a valuable compendium of practical issues and problems that space scientists and engineers would do well to focus their attention on. In a way, they would make the space scientists keep their feet planted firmly on solid ground!

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Book Review

Space debris 2000, Science and Technology Series, Volume 103

edited by J. Bendisch, Published by Univelt, Inc., P. O. Box No. 28130, San Diego, California 92128, USA, for the American Astronautical Society, San Diego, California, 2001, pp. xii + 356, $90.

Space debris poses a serious threat to artificial satellites and exo-atmospheric flight vehicles. Recent space shuttle flights have encountered such debris of various sizes and some of them have been big enough to come close to perforating the outer manifold of the spacecraft radiators. Anticipating this possibility, a section of the astronautical community of researchers has been engaged in identifying and tabulating the size, behavior, and orbit of space debris for the past few years. This volume constitutes the proceedings of the Space Debris sessions of the 33rd International Symposium on Safety, Rescue, and Quality held at Rio de Janeiro, Brazil, in October 2000, and contains several papers on various aspects of space debris.

There are several papers in this volume. To do justice to them one would need to discuss each paper separately, which indeed is a formidable task. On the other hand, it would be unfair to club several papers together based on some synthetic commonality and accomplish the review in a few short sentences. Hence, I chose to take the middle path and extract the essence of each paper in a couple of sentences so that the reader gets a fairly good idea of the paper s contents and can decide which paper to peruse in detail.

The papers in the volume are categorized under several sections. The first section contains papers on measurements and modeling of space debris and meteoroids. The paper by Settecerri et al. entitled Analysis of the Eglin radar debris fence presents orbital debris measurements and methodologies using the data collected by the FPS-85 phased array radar system operated as a radar search fence for space debris. The objective of the analysis is to provide enough data to allow analysis of the risk encountered by spacecraft launched in certain regions of space. The paper by Krag et al. entitled Debris model validation and interpretation of debris measurements using ESA s PROOF tool deals with the validation of the European Space Agency s (ESA s) Meteoroid and Space Debris Terrestrial Environment Reference (MASTER) model from actual measurements of space debris using PROOF (Program for Radar and Optical Observation Forecasting) which is a filter that transforms object data into detection rates. The next paper by Bernhard et al. on Space shuttle meteoroid and orbital debris impact damage considers data over the period of past five years on the impacts suffered by the space shuttles in a bid to identify the nature and size of the impacting debris or meteoroid. It is interesting to note that most of the debris sizes that impacted on the space shuttle are below 0.5 mm size and the largest is about 3.1 mm. The next paper by Alby et al. is on Space based observations of orbital debris and is motivated by the fact that debris of sizes lower than a few millimeters is difficult to identify and locate using ground-based radars and these have to be located using sensors on satellites. Several techniques to design such instruments are presented. The next two papers are a variation on the same theme. The one by Amorosi et al. entitled Space debris orbit estimation by optimal

measurements where catalogued orbital objects are tracked using the Italian TT1 telescope and a technique to improve the keplerian elements using the Lambert method is proposed. The paper by Isobe on Space debris observations at the Bisei spaceguard center describes the design of a dual telescope for space debris detection in Japan. The paper by Souza and Nunes entitled Forecasting space debris distributions: A measure theory approach is motivated by the premise that the standard covariance matrix propagation is not always fit for the purpose of forecasting space debris behavior or distribution mainly because of the distortion that the initial debris distribution undergoes due to gravitational effect. The title of the next paper by Liou et al. Updating the NASA LEO orbital debris engineering model with recent radar and optical observations and in situ measurements is self-explanatory. The paper by Bunte et al. entitled Application of the Divine approach to determine flux and spatial density resulting from space debris proposes a tool to predict debris population using an analytic approach proposed by N. Divine. The last paper in this section is by Smirnov et al. and is entitled LEO technogeneous contaminants evolution modeling with account of satellites collisions presents modeling of long-term orbital debris evolution based on continuous distribution functions and takes into account the possibility of inter-debris collisions.

The next group of papers is on risk analysis and protection. The first paper in this group is by Bendisch et al. and is entitled Object flux characteristics due to various types of debris sources . The object flux characteristics, in terms of speed and direction, are useful information to conduct risk analysis for space missions. The paper by Matney et al. is on Calculation of collision probabilities for space tethers . Space tethers pose collision hazard for spacecraft and are themselves susceptible to debris collisions. The models need to take into account the fact that unlike spacecraft, tethers can be several kilometers in length. The next paper by Anselmo and Pardini is also on space tethers and is entitled On the survivability of tethers in space . The paper reports the results of detailed numerical computations yielding average impact rates on tethers. The paper Artificial neural network analysis of space debris by Lewis et al. deals with the uncertainties associated with break up of artificial satellites that ultimately creates space debris. The break up in general causes asymmetric dispersion that simple models fail to capture. The artificial neural network model, on the other hand, is shown to produce a more faithful behavior. The paper by Katayama et al. entitled Numerical and experimental study on the shaped charge for space debris assessment describes an interesting experiment involving the acceleration of a minute aluminum particle of less than a gram weight to velocities exceeding 10 km/s using the shaped charge technique in order to test the protection capability of bumpers against space debris in laboratories. The next paper by Stokes et al. Achieving cost effective debris protection of unmanned spacecraft using SHIELD describes the development of a novel model called SHIELD that allows survivability assessment based not merely on penetration probability, but also on other indirect shielding effects that occur due to judicious arrangement of sensitive internal equipment in the spacecraft. The next paper by Takano et al. entitled Microwave generation due to hypervelocity impact describes a successful experiment to detect microwaves caused by debris impact with the ultimate objective of using this to sense and detect such impacts. The paper by Fritsche et al. is entitled Application of SCARAB to destructive satellite re-entries and describes software called SCARAB (Spacecraft Atmospheric Re-

entry and Aerothermal Breakup) that predicts the motion and destruction of space objects of arbitrary shapes entering the earth s surface and ultimately resulting in debris generation. The next paper by Reynolds et al. entitled A multifrequency airborne radar system for observing space system reentry describes the design of a new radar system to be installed on a mobile platform (KC-135 aircraft) to observe and track the reentry of the Ariane 5 main cryogenic stage, a potential space debris generator.

The last paper in this section is by Matney on A new approach to computing micrometeoroid fluxes on spacecraft and builds upon Divine s meteoroid population model to compute fluxes on spacecraft. The last section in this volume contains a variety of papers on mitigation measures and space debris handbooks and standards. The fist paper by Swinerd on Self-induced collision hazard in high and moderate inclination satellite constellations discusses the methodology for risk analysis for satellite systems such as IRIDIUM. The next paper by Kimura et al. on OMS for NeLS: A concept for a robot-assisted service for removing satellites from a LEO constellation describes the conceptualization of an orbital maintenance system (OMS) for removing failed satellites from the Next Generation LEO System (NeLS), a constellation of 120 satellites being envisaged by Telecommunication Advancement Organization (TAO) of Japan to facilitate highbandwidth multimedia communication. The paper by Konyuchov and Slyunyayev is on Analysis of ways to destroy the space debris and versions of spacecraft structures to clean the orbit proposes the construction of orbital scavenger type spacecraft that cleans debris caused by various launches. The paper by Heide and Krujiff is on Tethers and debris mitigation compares the advantage of using space tethers themselves to reduce space debris by momentum transfer or electrodynamic effect with the disadvantage of the tether itself posing a danger to satellites through several case studies. The paper by Kompanietz et al. on Minimization of space debris formation on Zenit-3SL ILV launches within the sea launch program proposes several technical issues related to minimization of orbital debris caused by spacecraft launches. The next paper by Hanada et al. on Consequences of continued growth in the GEO and GEO disposal orbital regimes examines the sensitivity of the long-term satellite population in the geo-synchronous orbit to the increasing orbital population density using computer models. Another study that considers longterm analysis of space debris population and its effect, in the low-Earth orbit is by Walker et al. in the paper entitled Studies of space debris mitigation options using the debris environment long term analysis (DELTA) model . The paper by Reynolds on The NASA orbital debris guidelines: An historical perspective on orbital debris modeling supporting the development of a policy on the use of space puts forward the viewpoint that since space debris mitigation as a requirement slowly became important over the years there was enough time to develop all the technical issues involved in this task and evolve standards that would simplify and order the measures taken to implement mitigation tools. The final paper on De-orbiting of the Compton Gamma Ray Observatory is by Ahmed et al. and describes the mission planning and step-by-step execution of various tasks in the successful de-orbiting of this scientific experimental laboratory in June 2000. The valuable lessons learned during this exercise are reported in the paper.

The worth of this volume is in the large number of papers that are based on actual systems, experiments, and observations. These will be invaluable assets to space

scientists dealing with debris mitigation and control.

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Book Review

A probability path

by Sidney I. Resnick, Birkhauser Verlag AG, Kl□sterberg 23, CH-4010 Basel, Switzerland, 1998, pp. 472, sFr. 108.

This is a book on basic notions and important basic results of probability theory. Obvious questions which cross one s mind are the following: what is the need for such a book when several books of this kind are already available in the market? What are the special features, if any, of this volume? Can one do without this book? There are no easy answers to such questions.

May be, one must first try to see what the present book has to offer to its readers. Foremost, it presents a quick review of basic notions, concepts and results in probability theory. More precisely, it deals with the following topics:

- Basic framework of probability space in which one can talk of random variables
- Independence
- Expectation, variance, etc.
- Various concepts of convergence of random variables and their inter-relations
- Versions of law of large numbers
- Characteristic functions of random variables
- Various versions of Central Limit Theorem
- Martingales and their convergence properties
- Some applications

People somewhat familiar with probability theory will readily see that the above topics would form a core of a first course on probability. The contents are organized in ten chapters and exercises. It is to be said that exercises are designed to supplement the information furnished by the BOOK REVIEWS 516 Tholasi Prints Mar Apr. Issue Received on No. Pgs. 9 1st proof Date: 17/10/02 SP (Book Review. p65) main text. The organization is very neat. Almost all major results are given names and this simplifies their identification and recalling at a later stage. The author has tried to combine good aspects of several classical books in the presentation. Compiled bibliography is not rich, neither in probability theory nor in applications. Speaking of applications, the present book includes a section on applications of martingales in mathematical finance. Recently, there was a sudden surge in research activities in modelling and studying finance, economics, banking, stock market, etc. in terms of dynamical systems and especially stochastic dynamical systems. To encourage these activities further among students, many new courses at graduate level have been designed in various universities all over the world to teach the students a mixture of areas of probability theory, partial differential equations, optimization, computations, etc. These courses target not just mathematics students; rather they are aimed at people from a variety of disciplines who would like to learn some fundamentals in other areas and use them in their own discipline. The present volume is suitable to offer such a course of one semester duration on the basics of probability theory. Though the material presented here is contained in classical books/papers, the value of the book lies in the fact that students and researchers

can find the material most relevant for applications, all grouped in one single volume.

Of course, I must hasten to add that many topics relevant to applications do not find place in this book. Examples include Brownian motion, stochastic integration, stochastic differential equations. For these topics, the reader may refer to many volumes existing already in the literature or a recent book on stochastic process by the author of the present book.

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Book Review

Collected papers of K-T. Chen

edited by Philippe Tondeur, Birkhauser Verlag AG, Kl□sterberg 23, CH-4010 Basel, Switzerland, 2001, pp.737, sFr. 348.

K-T. Chen was an outstanding, versatile mathematician. His work ranges from combinatorial group theory to Lie theory to homotopy theory and differential topology and geometry. In spite of such a wide spectrum,one can clearly discern an underlying coherence about all of his work.

Chen was a student of Samuel Eilenberg, a founding father of homological algebra and, even though Chen s work was not in homological algebra, one can see a subtle influence of the master on the pupil s earlier work.

Chen s first paper on Integration in free groups was his thesis work published in the Annals of Mathematics in 1951. This is intimately related to R. Fox s work on differential calculus in free groups although neither is a trivial consequence of the other. To elements in a free group, one attaches a path in an Euclidean space and an arbitrary polynomial is integrated along this path with respect to some coordinate. In this manner, each integral I (x)dxi gives a real-valued function on the free group. Chen obtains some nice properties of this integral which allows him to axiomatise the definition of such integrals. This, he applies in this paper, to the link groups of links in S3. These are defined as follows.

A link L is the disjoint union of a finite number of simple, oriented, closed curves in R3. The link group is the fundamental group p1(R3\L). In his next paper on Commutator calculus and link invariants , he continues to prove some combinatorial group-theoretic results on group presentations. He proves that for a finitely presented group G, the successive quotients in the lower central series can be efficiently presented. He discusses examples of link groups to show how his group-theoretic result facilitates distinguishing between some links. Following this, in his pathbreaking paper Isotopy invariants of links published in the Annals of Mathematics, Chen shows that for a link L in S3, the subquotients Gi/Gi+1 in the lower central series of the link group G=p1 (S3\L) are the same for a link isotopic to L. These are now known as the Chen groups of the link. Two smooth links are said to be isotopic if the associated embeddings into S3 can be deformed from one to the other via smooth embeddings.

In collaboration with R. Fox and R. C. Lyndon, Chen gives in Free differential calculus IV - published in the Annals of Mathematics-an algorithm to compute the lower central quotients Gn/Gn+1 for any finitely presented group G.

The next stage of Chen s work focusses on what are called formal differential equations and formal Lie theory. The setting here is a formal power series ring A= R << X1,...,Xn >> over R in n noncommuting variables X1,..., Xn. This is a Lie algebra and one works with the closure of the Lie subalgebra G generated by X1,..., Xn. Using the exponential and the logarithm maps, one obtains an infinite-dimensional Lie group whose Lie algebra it is. Chen works with such Lie groups G and with principal G-bundles over smooth manifolds M.

A trivialized principal G-bundle over M is a trivial bundle MxG M with a distinguished trivialization which is unique up to right multiplication by G. A connection on a trivialized bundle corresponds to a G-valued 1-form w on M via s = ds - sw for a section s. If w is such a connection on a trivialized bundle, one has the transport map Tw : PM G from the space PM of piecewise smooth paths in M, defined on any path g to be the result of parallel transporting the identity element along g.

Equivalently, Tw(g) = X(1), where X(t) is the solution of the initial-value problem

X' (t) = X(t)A(t), X(0) = Id

where A : [0,1] G is defined by g*w = A(t)dt. The last equation is called a formal differential equation. Chen obtains a beautiful formula for Tw in his paper Formal differential equations published in the Annals of Mathematics. Now, this formula involves so-called iterated path integrals. By this, one means the following.

Suppose w1, ..., wr are smooth forms on M which take values in an associative algebra A like the universal enveloping algebra U(G) or a power series ring. Suppose each wi has degree 1. Then Iw1....wr is an A-valued differential form on PM of degree rS i=1 (deg wi - 1). If Dr is the standard r-simplex in Rn, one defines a smooth function F : Dr x PM Mr by

F ((t1,...,tr), g) = (g(t1),...,g(tr)).

Then, the iterated integral is defined as
Iw1... wr = p* F* (w1 x ... x wr)

where p : Dr x PM PM is the projection and p* denotes integration over the fibre of p with respect to the volume from dt1 v ... w dtr.

In each wi is a 1-form, Iw1 ... wr is a function from PM to A which naturally generalises the line integral. This function takes a path g to

0 I t1 ... ... I tr 1 f1(t1) ... fr(tr)dt1 ... dtr.

The study of iterated path integrals gives powerful results on the cohomology of loop spaces. In fact, this is partly supposed to have inspired D. Sullivan s powerful work on minimal models . The study of such iterated integrals becomes a major program which occupied the last twenty years of Chen s life. The program studies the interaction of topolpgy and analysis through these integrals.

All of Chen s work carries technical power coupled with some attractive explicit formulae in between.

This volume also contains a concise introduction to Chen s work written by Phillippe Tondeur and Richard Hain, also a student of Chen.

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Book Review

Resolution of singularities

by H. Hauser, J. Lipmann, F. Oort, A. Quir□s, Birkhauser Verlag AG, Kl□sterberg 23, CH-4010 Basel, Switzerland, 2000, pp. 624, sFr. 138.

Stated roughly, the problem of resolution of singularities asks the following: Given a variety V, does there exist a nonsingular variety V□ dominating V properly and birationally.

The problem has a long history and is still not completely solved. The cases for which the problem has been solved (with an affirmative answer) include:

1. The case of curves. This is classical.
2. Any variety over a field of characteristic zero. The solution in this case was obtained by Oscar Zariski in 1939 for surfaces and in 1944 for threefolds, and by Heisuke Hironaka in 1964 for varieties of arbitrary dimension.
3. Surfaces and almost all cases of threefolds over a field of positive characteristic. The solutions in these cases were obtained by S. S Abhyankar in 1956 and 1966.

There has been a considerable amount of activity in this area and a large body of related contributions has appeared in print, particularly over the last four decades.

The book under review sets for itself a twofold goal: One, to introduce the nonspecialist mathematician to various aspects of this important problem; two, to collect together several current research articles on the subject dealing with diverse aspects of the problem and stating some open questions.

The book attains the goal reasonably well.

The contents of the book are expanded versions of four courses taught at a Working Week held in Obergurgl, Austria, in September 1997. Articles are based on talks given at the Working Week, and some written especially for this volume.

The four courses were as follows:

1. Alterations and resolution of singularities by D. Abramovitch and F.Oort. The main thrust here is a sketch of the recent proof by De Jong of the alteration of a variety of arbitrary dimension over a field of arbitrary characteristic to a nonsingular one. (An alteration is a domination of V by V□ which is proper and generically finite, a condition weaker than birationality.) The write-up also covers some applications and related results.
2. Reduction of singularities for differential equations by J. -M. Aroca.
3. Puiseux solutions of singular differential equations by J.-M. Aroca.
4. A course on constructive desingularization and equivariance by S. Encinas and O. Villamayor.

Some of the highlights of the book are as follows:

- A brief life sketch of Oscar Zariski.
- A history of the progress made so far on the problem, with individual contributions listed.
- A dictionary giving definitions of the technical terms used in the subject.
- A large bibliography.
- Sixteen research/survey articles dealing with diverse aspects of the problem.
- Listing of some research problems.
- An interesting note by H. Reitberger on some false or incomplete proofs of resolution of singularities which appeared in print during the period 1944 to 1964.

The book, which is quite well written, would be a valuable addition to the library of any institution where there are mathematicians interested in any area of algebraic geometry or commutative algebra.

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Book Review

Algebra, some recent advances

edited by I. B. S. Passi, Birkhauser Verlag AG, Kl□sterberg 23, CH-4010 Basel, Switzerland, 2000, pp. 249, DM 170/sFr. 128.

The Indian Science Academy, as a part of its programme to bring out monographs in special topics with the aim of providing survey articles of current research interest in various fields, requested Professor I. B. S. Passi to edit a volume in algebra. This is the outcome of this effort and comprises 16 mostly survey articles written on his invitation. Many of them are on group rings.

Apart from articles on group rings, there are articles on diverse topics, for example: on abelian difference sets by K. T. Arasu and S. K. Sehgal; on projective modules over polynomial rings by S. M. Batwadekar; on automorphisms of relatively free groups by C. K. Gupta; Galois cohomology of classical groups by S. Parimala; L-valued at zero and the Galois structure of global units by J□rgen Ritter; on the transitivity of normality and permutability properties in groups by D. J. S. Robinson; most of the articles are surveys and the topics are too diverse.

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Book Review

Advances in geometry

by J. L. Brylinski et al., Birkhauser Verlag AG, Kl□sterberg 23, CH- 4010 Basel, Switzerland, 1999, pp. 416, sFr. 98

This is a collection of 17 papers of generally high quality, which are declared in the preface to be an outgrowth of the activities of the Center for Geometry and Physics at Penn State from 1996- 1998 . They reflect the interests of the editors, and the unifying thread is what may be called the algebra of symplectic geometry . Symplectic manifolds, which are generalisations of the Phase space of classical mechanics, have become the subject of intense interest in mathematics over the past two decades, with the realization that symplectic geometry is central to many disparate fields of mathematical enquiry-from group representations to geometric invariant theory and quantum groups. (Parenthetically, let me also mention the explosion of interest in the topology of symplectic manifolds, sparked off by the work of M. Gromov, D. McDuff, S. Donaldson and others. As far as I know, this has its roots in the internal logic of mathematics, and little, if any, connection with physics. This is not one of the concerns of the book.)

Many of the papers are concerned with deformation quantisation -the construction of deformations of the Poisson algebra of functions on a symplectic (or more generally, Poisson) manifold. The deformed product of two functions (which is no longer commutative) goes by the name of star product after the notation used in the early papers. The spectacular achievements of Kontsevich in deformation quantisation have been missed; presumably they came after the book had been sent to the publisher.

Quantum groups and quantum cohomology form another major theme, and in particular the quantum cohomology ring of flag manifolds and related combinatorics.

Much attention has been focussed in recent years on the moduli spaces of vector bundles on a Riemann surface, a field which never ceases to surprise. The symplectic geometry of these spaces is the subject of one of the articles, one of the few in which the geometry comes to the fore. The connection with symplectic geometry is made courtesy of the Narasimhan-Seshadri theorem which identifies these (algebraic-geometric) spaces with the spaces of representations of the fundamental group of the surface. Other fundamental groups are also studied, but from a more algebraic point of view. Two papers by J-L. Brylinski study secondary characteristic classes, Quillen metrics, Deligne cohomology and gerbes. These address issues which have recently become very fashionable in the context of string theory, where analogues of gauge-theoretic Lagrangians for forms of degree higher than one have made their appearance.

Other topics addressed in the collection are differential operators on nilpotent orbits, contact geometry (a close relative of symplectic geometry) and the Yang-Baxter equation.

No research library can afford not to have this collection. However, I do have a reservation. This concerns the appropriateness of publishing what is essentially a set of research papers as a book rather than in standard journals. Such a procedure can be justified, in my view, only if the papers have a substantial pedagogic content.

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