BOOK REVIEW Impressive Breath and Coverage

Mathematics and Technology

by Christiane Rousseau and Yvan Saint-Aubin,
Springer Verlag 2008.
582 pages $ 59.95 US ISBN 978-0387692159

Reviewed by Theodore Kolokolnikov, Dalhousie University, Dept. of Mathematics.

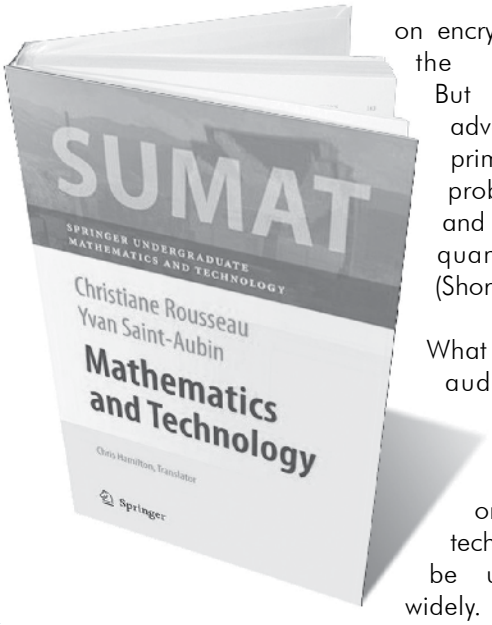
As its title suggests, *Mathematics and Technology* presents a collection of applications of mathematics to some specific problems in everyday life. The breadth of topics covered is impressive, and includes cryptography, error-correcting codes, GPS signals, image compression (fractal compression and jpeg standard), sound encoding, random number generation, web searching, DNA and quantum computing, robotic motion, calculus of variations, and many others.

The book is organized into fourteen chapters, each covering a particular application, plus an extra chapter "science ashes", that covers a variety of shorter topics. Each chapter includes interesting historical notes and references at the end. Many exercises of various difficulty (from elementary to term projects) are also included. Illustrations enliven the exposition. At the beginning of every chapter, the authors conveniently summarize the topics covered, the amount of class time required, as well as the prerequisite background. All chapters are completely independent of each-other and can be read in any order. This organization makes it easy to pick topics to adapt for teaching a particular class.

Despite the book size (over 550 pages), the material is presented in a very concise way. Every effort was made to make the topics accessible to anyone with just basic knowledge of calculus and linear algebra. Each chapter starts with relatively easy material before moving on to more advanced topics. Many topics are introduced first through concrete examples. This then serves as a springboard to more abstract ideas and generalizations. Along the way, the relevant mathematical theory is covered as needed.

For example the chapter on fractal image compression starts with a discussion of iterated maps. Fern leaf is used as an example, and a simple Mathematica program is included that generates it. It goes on to prove convergence of contracting maps. This is then generalized to Banach fixed-point theorem. Some key ideas of real analysis such as metric spaces are introduced in the process. This is followed by a discussion of the Hausdorff distance between sets, and fractal dimension. Finally, fractal image compression is presented, along with a concrete example and comparison to other popular techniques. At the end are 16 exercises that explore the topics in more detail and provide further examples. The whole chapter is around 40 pages, including more than a dozen illustrations.

Despite a wide range of applications covered, many topics are treated with much depth. As an example, the chapter



on encryption first discusses the RSA algorithm. But it also has more advanced sections on primality testing using probabilistic methods, and factorization using quantum computers (Shor's algorithm).

What is the intended audience? Initially, the authors developed this book for a course on mathematics and technology. But it can be used much more widely. For teachers of undergraduate mathematics, this book can provide valuable material to motivate much of the standard mathematics curriculum. To give but one example, a chapter on Google's PageRank algorithm for web searching can be used as a nice way of introducing eigenvalues. For students, many chapters can be used as a source for projects or independent study. Finally, *Mathematics and Technology* can be used to motivate high school students to pursue mathematics (or other sciences). Unlike some popularizations of mathematics, *Mathematics and Technology* actually gives a taste of what mathematics is all about. It walks through detailed examples that are interesting and relevant to everyday life. And it does so in a way that is accessible to high school students, without hiding the mathematical intricacies involved.

In conclusion, *Mathematics and Technology* is a delightful book. The breadth as well as depth of topics covered means there is something for everyone. It is written with great care and the material never feels dry or pedantic. Highly recommended.

Letters to the Editors
Lettres aux Rédacteurs

The Editors of the NOTES welcome letters in English or French on any subject of mathematical interest but reserve the right to condense them. Those accepted for publication will appear in the language of submission. Readers may reach us at notes-letters@cms.math.ca or at the Executive Office.

Les rédacteurs des NOTES acceptent les lettres en français ou anglais portant sur un sujet d'intérêt mathématique, mais ils se réservent le droit de les comprimer. Les lettres acceptées paraîtront dans la langue soumise. Les lecteurs peuvent nous joindre au bureau administratif de la SMC ou a l'addresse suivante : notes-lettres@smc.math.ca.