Mathematical Research and Publishing

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Curves and Surfaces

Alfred Gray's book *Curves and Surfaces* will be published by CRC Press in 1992. This book is a traditional textbook for a differential geometry course, but what makes it different is its use of *Mathematica*. *Mathematica* Notebooks of the textbook will be available for those platforms that support Notebooks. Following are some of the aims of the book:

- To show how to use *Mathematica* to plot many interesting curves and surfaces.The book contains many more examples than standard textbooks do. Using the techniques described in *Curves and Surfaces*, students and teachers understand concepts geometrically by plotting curves and surfaces on a monitor and then printing them. The effect of changes in parameters can be strikingly portrayed.
- To show how to define and compute standard geometric functions such as the curvature and torsion of a curve in space. When the curvature and torsion become too complicated, they may be graphed instead.
- To define operators that construct new curves and surfaces from old. For example, there is a simple program that generates a surface of revolution from a plane curve.
- To apply techniques from numerical analysis in the differential geometry of curves and surfaces.

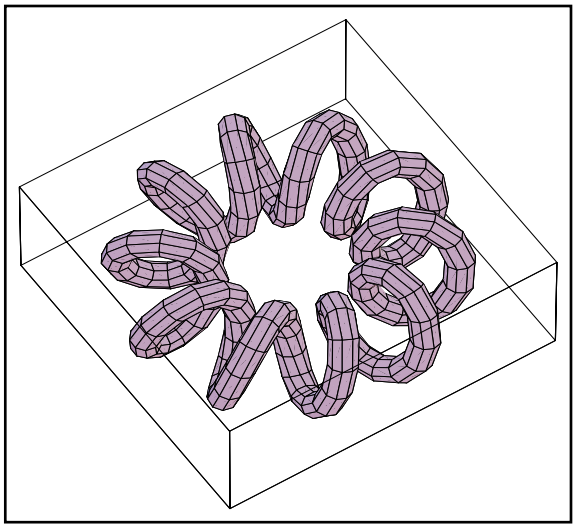

Figure 1 *A tube about a spiral on a torus*

Geodesics

Gray has written *Mathematica* programs for finding geodesics on an arbitrary surface and displaying them. These programs, written in *Mathematica* Notebook form, allow students and researchers to study geodesics interactively.

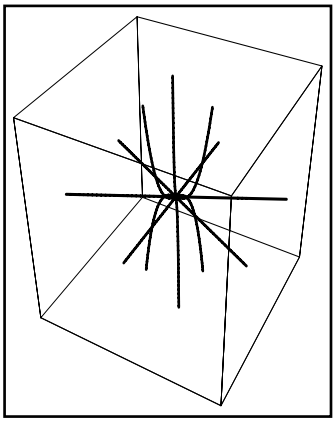

Figure 2 *Geodesics on a monkey saddle*

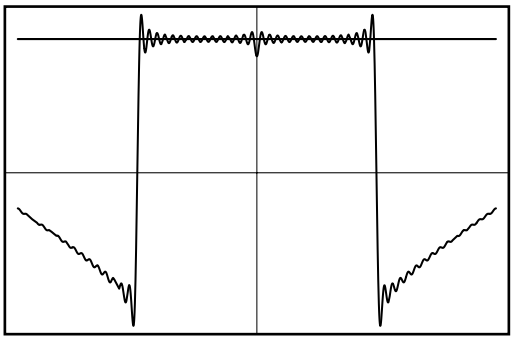

Figure 3 *A new Gibbs' phenomenon*

Gibbs Phenomenon for Bessel Functions

While Gray was writing "Using *Mathematica*" he discovered that there is a Gibbs for Fourier-Bessel Series that behaves somewhat differently from that of ordinary Fourier series. The ordinary Gibbs phenomenon consists of overshoots by the Fourier series at points of discontinuity. In addition to this type of Gibbs phenomenon, a Fourier-Bessel Series can exhibit similar behavior at points of continuity.

In spite of the fact that Gibbs phenomenon has been a subject of intense interest for mathematicians and physicists for more than 75 years, this behavior had not been observed. Gray and Mark Pinsky have now established the analytical reasons for this new Gibbs phenomenon. On NeXT computers, *Mathematica*'s powerful interactive graphics is thus a very important tool in research. In contrast to research articles, new results can be distributed in an interactive form that makes them much more accessible to both students and researchers.

The Benefits of NeXT Technology for Mathematical Publishing

A NeXT workstation is the most convenient place to use *Mathematica*. First, the ability to combine text and graphics in one file makes working with *Mathematica* on a NeXT computer much easier than on other workstations. Even if other workstations have windows, they do not have Notebooks. Second, editing is much easier. Working is three times faster on a NeXT than on another workstation. Third, it is easy to transfer information between *Mathematica* and word processors. When I write a research article that requires graphics, I work with TEX and *Mathematica* simultaneously. I generate the graphics with *Mathematica,* write the article with TEX, and put the graphics in the TEX document.

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Alfred Gray is a Professor of Mathematics at the University of Maryland. He received his B.A. (1960) and M.A. (1961) in Mathematics from the University of Kansas, and his Ph.D. (1964) in Mathematics from UCLA. His main field of interest is differential geometry; he has written more than 90 research articles on that subject. His book Tubes*—one of the first research monographs to use Mathematica graphics—was published by Addison-Wesley in 1990. Gray wrote the appendix, "Using Mathematica," for Mark Pinsky's* Partial Differential Equations and Boundary Value Problems with Applications, *published by McGraw-Hill in 1991. Gray speaks Spanish, Italian, French, Portuguese, German, and Russian. His joint research project with Spanish mathematicians in Bilbao and Santiago de Compostela has published many articles on complex and symplectic geometry.*