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1 Publications

I was fortunate in having the opportunity to do research in a number of different areas of mathematics. Nowadays, with the pressure to continuously publish, it would be much more difficult if not impossible to have the luxury of exploring new fields.

1.1 Fractals and Stochastics

A lucky break came with [Hut81], it languished for a few years but then generated a lot of activity. On sabbatical in 1978 in Princeton, and at the suggestion of Fred Almgren, I undertook the project of putting some of the work on fractals by Benoit Mandelbrot into a unified mathematical framework. There has been a lot of subsequent work by others and each year since 2000 (when records were first kept), according to the American Mathematical Society this paper has been in the top 100 most cited articles in the mathematical literature, and some years in the top 10. Michael Barnsley and John Elton later took a different approach via “the chaos game” and Michael subsequently created a company and successfully developed software and hardware to extend these ideas to image compression.

The papers [HR98, HR00a] with Ludger Rüschendorf develop a random version of this approach. In [BHS03, BHS05, BHS08, BHS12] with Michael and Örjan Stenflo the notion of $V$-variable fractals is developed. These are random fractals which in some sense are intermediate between homogeneous random fractals and standard random (i.e. recursive) fractals. The unpublished [BHS03] is an informal user-friendly introduction. [FHH17] with Uta Freiberg and Ben Hambly gives a detailed analysis of the spectral properties of $V$-variable fractals.


1.2 Geometric Measure Theory,
Analytic Methods for Geometric Problems

The landmark paper Normal and Integral Currents by Federer and Fleming was a major breakthrough in the study of geometric variational problems. In 1975 at the ANU, Neil Trudinger encouraged a number of us to run a seminar series on Federer’s book Geometric Measure Theory. At around the same time Enrico Giusti visited the ANU and gave a series of lectures on a related approach due to De Giorgi for hypersurfaces.

[Hut81] answers a question of De Giorgi, pointed out to me by Giusti, concerning the equivalence of two measures for hypersurfaces, and gives a negative answer with the proof motivated by fluid flow around a Cantor type set in the plane. [Hut86] develops a suggestion of Leon Simon and introduces a generalised notion of curvature for objects potentially with singularities. Related regularity issues are addressed in [Hut86,Hut87,Hut90]. The nonuniqueness of tangent cones in [HM86] with Michael Meier answers a small question of Allard. The paper [FH97] with Yi Fang introduces a number of novel ideas, but unfortunately has slipped under the radar. [HT00] with Yoshi Tonegawa studies phase transition interfaces in the geometric measure theory setting.


1.3 Numerical Analysis for Geometric Problems

In the early 1990’s, through the Centre for Mathematical Analysis [CMA] directed by Neil Trudinger and containing a very active research group led by Leon Simon, I met Gerd Dziuk. This led to a fruitful collaboration [DH94] ... [DH06] and [Hut91] involving theoretical and numerical work concerning geometric problems.


1.4 Multivariable Variational Problems, Regularity and Singularities of Solutions

In the same CMA milieu as mentioned before, but a few years earlier, I met Nicola Fusco. This led to another very fruitful collaboration, with [FH85] ... [FH95] motivated initially by Giaquinta’s book Multiple Integrals in the Calculus of Variations and Nonlinear Elliptic Systems. Separately, [AFH03] with Luigi Ambrosio and Nicola studies the dimension of the singular set for the Mumford-Shah functional used in image segmentation and pattern recognition.


[FH85], C³,α partial regularity of functions minimising quasiconvex integrals, Manuscripta Math. 54 (1985), no. 1-2, 121–143.

1.5 Mathematical Logic, Model Theory & Set Theory

After many enjoyable years as a graduate student at Stanford just south of San Francisco, but not fruitful by way of publishable mathematics, I changed supervisors to Harvey Friedman. Harvey at 18 was younger than any graduate student, and had just taken up a position at Stanford after his PhD from MIT. Following some reading suggestions of his, I came up with the result in [Hut76c] which gave a new class of extensions of models of set theory. Since I was slow but careful, when Harvey said he did not believe the result I knew it was an interesting one, and anyway the next day he said he did believe it. [Hut76a] uses these and other ideas to give a short and unified way of proving old and then
new results for infinitary logics. [Hut76a] classifies the order types of ordinals when seen from outside
the model itself of set theory.

On returning to Australia after my PhD there was little in the way of activity in the field of
mathematical logic and so I resolved to change fields. I was fortunate to obtain a position at the ANU
and then took the opportunity to move into the general area of geometric measure theory in 1.2.


2 Grants

- A Numerical and Theoretical Study of Models for the Evolution of Interfaces with G. Huisken
  and S. Roberts, Faculties Research Fund, 1989, 90
- A Numerical and Theoretical Study of Models for the Evolution of Interfaces with G. Huisken
  and S. Roberts, 1989–91, Australian Research Council (ARC) large grant (A68830148)
- Theoretical and Numerical Aspects of Geometric Variational Problems with G. Dziuk and G.
  Huisken, 1990, a bilateral exchange workshop, DITAC and German Research Foundation
- Nonlinear Analysis and Geometric Problems with R. Bartnik, G. Huisken, N. Trudinger, J.
  Urbas, ARC large grant (A69031884), 1991-94 (rolled over)
- An Investigation of Finite Element Approximations to Minimal Surfaces, H-surfaces, and to
  Systems of Partial Differential Equations; and of Theoretical and Computational Aspects of
  Nonlinear Elasticity Type Problems ARC small grant F95078, 1995
- A Mathematical Investigation of Curvatures and Various Energies Related to Geometric and
  Physical Problems ARC large grant (A69602500), 1996-99 (rolled over)
- Numerical Algorithms for investigating physical and geometric processes 2001-2002, Australian-
  German Joint Research Co-operation Scheme
- Theoretical and Computational Investigations into Nonlinear Geometric and Physical Variational
  Problems ARC large grant (A001042272), 2001-2004 (rolled over)
- A new generation of fractals: theory, computation, and applications particularly to digital imaging
  with M. Barnsley, ARC large grant (0558974), 2005-2010 (rolled over)

3 Patent

Fractal image data and image generator with M. Barnsley, and Ö. Stenflo, through ANUTech

- Australian Provisional Patent, March 2003
- Shortlisted – Secrets of Australian IT awards 2003
- ACT Knowledge Fund Grant 2004 ($25,000)
- International Provisional patent, March 2004
- Publication of US20070040848A1, February 2007
- Application Status: abandoned, May 2019

Unfortunately, this ended up in the category of a solution looking for a problem.


4 Links to Articles

Google Scholar
Mathscinet from ANU
Mathscinet with other login