University of Birmingham

# Dr Warren R. Smith BSc, MSc, DPhil

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## About

Warren has published over 25 research papers in scientific journals in the fields of mathematical modelling and perturbation theory. He has received grants from the EPSRC and has collaborated with research groups in the Netherlands, United States and world-leading multinationals.

Warren has pioneered the application of strongly nonlinear analysis to the Navier-Stokes equations. Original results have resulted for the decay rate of the oscillations of viscous drops and the modulation equations for travelling waves.

## Qualifications

- PG Cert in Learning and Teaching 2003
- DPhil in Mathematical Modelling 1992
- MSc in Mathematical Modelling and Numerical Analysis 1990
- BSc (Hons) in Mathematics 1989

## Biography

Warren Smith obtained a first class BSc (Hons) in Mathematics from Warwick University in 1989. He then moved to Exeter College, Oxford to attend the taught MSc in Mathematical Modelling and Numerical Analysis and study for a DPhil modelling the latest design of Rolls-Royce gas journal bearing.

His doctorate was followed by a short period in scientific consultancy, an EPSRC-funded Postdoctoral Research Assistant in the University of Nottingham and an EU-funded ECMI Research Fellowship in TU Eindhoven. In 2001, he accepted a Lectureship at the University of Birmingham in which he remains apart from a three-month fellowship at Cornell University.

Warren acts as a reviewer for more than ten leading scientific journals, the research councils and AMS Mathematical Reviews. He has been invited to contribute to a special issue of the Journal of Engineering Mathematics, delivered invited lectures at mini-symposium and organised a study group for mathematics in industry in the Netherlands.

## Teaching

- Applied Mathematics II
- Continuum Mechanics

## Postgraduate supervision

- Mathematical modelling of planar-flow spin casting
- Strongly nonlinear analysis applied to the Navier-Stokes equations

## Research

**RESEARCH THEMES**

- Perturbation theory
- Strongly nonlinear analysis

**RESEARCH ACTIVITY**

In the last few years, Warren has pioneered the application of strongly nonlinear analysis to the Navier-Stokes equations. This analysis has already succeeded in determining a quadratic variation in decay rate with amplitude for the oblate-prolate oscillations of a viscous drop of incompressible fluid. It has also determined modulation equations for finite-amplitude laminar nonlinear waves in an incompressible fluid at high Reynolds number.

Throughout his academic career, Warren has sought after multi-scale industrial topics. These allow the application of regular perturbation theory (for example, in laser percussion drilling) or singular perturbation theory (for example, in semiconductor lasers). The European Study Groups with Industry (ESGI), links with ECMI and interdisciplinary collaboration have provided sources for these projects. During his career, he has collaborated with mechanical engineers (Brunel, Oxford), electrical engineers (Nottingham), chemical engineers (Cornell, Eindhoven) and physicists (Eindhoven).

## Publications


W. R. Smith. (2010) Modulation equations for strongly nonlinear oscillations of an incompressible viscous drop. J. Fluid Mech., 654:141-159

B. P. Cox and W. R. Smith. (2008) On a multiple-scales analysis of multilateral phenomena in semiconductor lasers. SIAM J. Appl. Math., 69:1-21

A. B. Bichi, W. R. Smith and J. G. Wissink. (2008) Solidification and downstream meniscus prediction in the planar-flow spin casting process. Chem. Eng. Sci. , 63: 685-695

W. R. Smith. (2007) Modulation equations and Reynolds averaging for finite-amplitude nonlinear waves in an incompressible fluid. IMA J. Appl. Math., 72:923-945

W. R. Smith. (2007) Explicit modulation equations, Reynolds averaging and the closure problem for the Korteweg-deVries-Burgers equation. IMA J. Appl. Math., 72:163-179

W. R. Smith and R. M. M. Mattheij. (2007) Solidification of a two-dimensional high-Reynolds-number flow and its application to laser percussion drilling. Eur. J. Appl. Math., 18:1-19

B. P. Cox and W. R. Smith. (2007) Predictions of thermoelastic stress in a broad-area semiconductor laser. Appl. Phys. Lett., 90:121105

W. R. Smith. (2005) On the sensitivity of strongly nonlinear autonomous oscillators and oscillatory waves to small perturbations. IMA J. Appl. Math., 70:359-385

W. R. Smith. (2004) The propagation and basal solidification of two-dimensional and axisymmetric viscous gravity currents at large Bond number. J. Eng. Math., 50:359-378

J. C. J. Verhoeven, J. K. M. Jansen, R. M. M. Mattheij and W. R. Smith. (2003) Modelling laser induced melting. Math. Comp. Modelling, 37:419-437

J. G. Byatt-Smith, A. A. Lacey, D. F. Parker, D. Simpson, W. R. Smith and J. A. D. Wattis. (2003) Mathematical modelling of homeless populations. Math. Scientist, 28:1-12

W. R. Smith and H. J. J. Gramberg. (2002) Mathematical modelling of moisture induced panel deformation. Invited special issue of J. Eng. Math. on industrial applied mathematics. 43:347-366

W. R. Smith and L. N. Bobrova. (2002) Mathematical modelling of a reverse flow reactor with catalytic surface dynamics. Chem. Eng. Sci. 57:393-407

W. R. Smith. (2002) Models for solidification and splashing in laser percussion drilling. SIAM J. Appl. Math. 62:1899-1923

W. R. Smith. (2001) One-dimensional models for heat and mass transfer in pulse-tube refrigerators. Cryogenics 41:573-582

W. R. Smith, J. R. King and B. Tuck. (2001) Mathematical modelling of electrical-optical effects in semiconductor laser operation. SIAM J. Appl. Math. 61:2122-2147

W. R. Smith. (2000) Mathematical modelling of thermal runaway in semiconductor laser operation. J. Appl. Phys. 87: 8276-8285