Jamal Uddin

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Research Summary

I am interested in the rupture of liquid jets and films with an emphasis on droplet (or filament) formation and in particular methods to control the size of droplets with applications to industry. Examples include the applications of surfactants, thermal modulation and complex fluids and their use in encapsulated droplets for drug delivery and the concealment of taste in foods. My other interests include free surface hydrodynamics including determining the profile of a free surface interacting with a violently accelerated solid body with applications to ship slamming and dam breaking. I have interests in modelling fuel cells and in particular flow over reacting boundaries.

Education

- **The University of Birmingham** — Birmingham, UK
  PhD in Mathematics — *Sep. 2004 - Aug. 2007*
  - Thesis Title: Controlling breakup and droplet formation in single and compound liquid jets.
  - Supervised by Professor Stephen P. Decent (Mathematics) and Dr. Mark J. Simmons (Chemical Engineering).
- **The University of Birmingham** — Birmingham, UK
  M.Sci. in Mathematics — *Sep. 2000 - July. 2004*
  - First Class Honours
  - M.Sci project title: Spiralling non-Newtonian liquid jets
- **Joseph Chamberlain College**
  A levels in Mathematics, Physics and Further Mathematics — *Sep. 1999 - July. 2000*
  - Grades AAB
  - Mathematics grade A achieved in 1999
- **Saltley School**
  GCSE — *Sep. 1994 - July. 1999*
  - 9 A* and A grades including English, Mathematics and Science.

Awards and Prizes

- **Excellence in Teaching Award**, 2009, University of Birmingham
- **UK-Ireland SIAM Best Presentation Prize**, 2006, 48$^{\text{th}}$ British Applied Mathematics Colloquium (Keele University).
- **Watson Scholarship in Mathematics**, 2000, University of Birmingham. Entered university aged 17 and completed an A level in Mathematics at grade A achieved aged 16.
- **Fellowship in Hydrodynamics**, 2007, University of Birmingham.

Current research interests

- **Free surface flows** - rupture of liquid jets and films, droplet formation, cusps, flow singularities, similarity solutions.
- **Medicine and Pharmaceutics** - thin film flows in drug delivery, encapsulation of liquids in gels, micro-droplet formation for use in aerosols.
- **Numerical Methods** - finite difference equations, Lax-Wendroff method, unsteady harmonic boundary value problems, solutions to ODEs and boundary element problems.
- **Asymptotics and Perturbation** - small time solutions of classical problems, multiple scales and asymptotic matching.
- **Non-Newtonian fluids and advanced materials** - power law fluids, Carreau fluids, Bingham plastics, visco-elastics, polymers and nano-layers and films.
- **Energy** - Fuel cells, optimization and storage.

Employment

- **The University of Birmingham** Birmingham, UK
  Research Fellow in Hydrodynamics *Nov. 2007 - Present*
  - Collaborating with Prof. D. J. Needham on determining the local structure near an interacting plate and free surface. Use of boundary integral methods to solve non trivial inner problems. Collaborating with Prof. J. Billingham (Univeristy of Nottingham) and Dr. P. Chamberlain (University of Reading).
  - Includes research on jet breakup and collaboration with the School of Chemical Engineering.
  - Lunchtime Applied Mathematics Seminar Coordinator (Postgraduate Students).
  - Departmental Applied Mathematics Seminar Organizer.
  - MSM3A05: Full responsibility for third year course in Asymptotics and Perturbation theory.
  - Teaching to about 40 students (up from 12 in previous year) from Year 3/4.
  - Co-supervisor to PhD student working in asymptotic structure of linear and nonlinear waves leading to liquid jet rupture.
  - Co-supervisor to 2 M.Sci. students working on Single Chamber Solid Fuel Oxide Cells.

Journal Publications

- Peer Reviewed Publications
  - J. UDDIN, S.P. Decent and M.J. Simmons, 2006, *'The instability of shear thinning and shear thickening spiralling liquid jets: linear theory',* J. of Fluids Eng, **128**, 55, pp. 968-975.
  - J. UDDIN, S.P. Decent and M.J. Simmons, 2008, *'The effect of surfactants on the instability of a rotating liquid jet,'* Fluid Dyn. Res. **40**, 11-12, pp. 827-851.
  - J. UDDIN,S.P. Decent and M.J. Simmons, 2008, *'Non-linear waves along rotating non-Newtonian liquid jets,'* Int. J. Eng. Sci. **46**, pp. 1253-1265.
  - J. UDDIN and S.P. Decent 2009, *'Curved non-Newtonian liquid jets,'* J. of Fluids Eng. **131**, Issue 9, 091203

  - S. Decent, A. King, M. Simmons, E.I., Parau, D. Wong, I. Wallwork, C. Gurney, J. UDDIN, 2009, *'The Trajectory and Stability of Spiralling Liquid Jets: Viscous Theory,'* App. Math. Mod. 33, 12, pp 4283-4302,
  - J. UDDIN and S. P. Decent *'Non-Newtonian jets curved by gravity,'* 2009, accepted in ECMI Proc. Mathematics in Industry, Springer

- Publications - submitted
  - V. Hawkins, M. J. Simmons, J. UDDIN and S. P. Decent, 2009, *'Drop generation from spiralling non-Newtonian liquid jets,'* submitted to Exp. in Fluids.
  - V. Hawkins, C. J. Gurney, M. J. Simmons, S. P. Decent and J. UDDIN, 2009, *'Unstable waves on a curved non-Newtonian liquid jet,'* submitted to Journal of Physics A .

- Publications - in preparation
  - J. UDDIN and S.P. Decent, 2009, *'The instability of a periodically heated non-Newtonian liquid jet.'*
  - J. UDDIN and D. J. Needham, 2009 *'Free surface interaction with an accelerating plate.'*

Conferences Proceedings

- International Conference on Multiphase Flow, ICMF Leipzig, 2007. V. L., Hawkin, C. L., Brisbane, M. J. H. Simmons, S. P., Decent, J. UDDIN *'Break-up of spiralling non-Newtonian liquid jets'.*

Academic Conferences (Talks Given)

- The European Consortium For Mathematics In Industry, ECMI London, July, 2008.
- Oxford Centre for Industrial and Applied Mathematics OCIAM meeting in Hydrodynamics, University of Oxford, May, 2008.
- 50^{th} British Applied Mathematics Colloquium, BAMC, Manchester, April, 2008.
- European Postgraduate Fluid Dynamics Conference, EPFDC, July 2007.
- 49^{th} British Applied Mathematics Colloquium, BAMC, Bristol, April, 2007.

Educational (Talks Given)

- Mathematics Teachers Conference, University of Birmingham, "Mathematics: a way to understand how and why things work!" July 2009.
- Joseph Chamberlain Sixth Form College, Birmingham, Masterclass - "Mathematics in Higher Education", July 2009.

Computational Expertise

I am fluent in a range of mathematical software including MATLAB, MAPLE, MathCAD and FORTRAN. I have expertise in finite difference schemes (implicit and explicit) with variable time stepping, numerical integration, iterative solutions and Runge-Kutta methods. Furthermore, I am

familiar with boundary element methods with a particular emphasis on solving harmonic problems. A summary of my numerical expertise is listed below

Affiliations

- Junior member of Isaac Newton Institute of Mathematical Sciences (University of Cambridge).
- Member of the Center for Mathematical Modelling and Chemical Engineering (CMMCE).

Other work experience

- International Secretary for the Postgraduate Committee (University of Birmingham).
- Chair of session for the first ever European Fluid Dynamics Conference.
- Tutor in A Level Mathematics (individual and small group teaching) 2003-04.
- Laboratory Assistant in School of Psychology (University of Birmingham) 1998. Working alongside Prof. Jane Riddoch to investigate memory loss and audio-visual ability of stroke victims.

References

Professor David J. Needham
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Professor Stephen P. Decent
PhD Supervisor and Head of School
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