Jamal Uddin, *PhD.*

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Summary

I am interested in developing mathematical/computational models to capture the essential physics behind problems in industry and engineering which revolve around fluid mechanics. I work closely with various interdisciplinary groups both nationally and internationally with the aim of applying my mathematical expertise to research which is both novel and cutting edge. My current research projects include work on particle collisions, free surface hydrodynamics, rupture of liquid jets and films, oscillations in fuel cells and liquid curtain coating. I am also a passionate advocate of novel ways in teaching undergraduates especially by drawing on current themes and research topics. I am dedicated to the development of the School of Mathematics as a whole and take an an active role in its admissions strategy and international outlook.

Key Facts

- **16 High Quality A/A* publications with 11 in the last 4 years.**
- **3 funded postdoctoral students in last 5 years.**
- **Lead supervisor of 5 PhD students (4 already graduated) and a further 2 as co-supervisor.**
- **Extensive international collaborations and proven track record in obtaining funding from external bodies.**
- **Visiting Professorships at KAUST (Saudi Arabia) and UTM (Malaysia).**
- **Recipient of Excellence in Teaching Award.**
- **Recipient of UK-Ireland SIAM Award.**
- **Successful Grant for innovative interactive teaching.**
- **Director of Admissions during critical and improved admissions cycles.**
- **Provisionally part of 2 REF Impact Case Studies for 2020.**

Education

University of Birmingham — Birmingham, United Kingdom

PhD in Applied Mathematics — *2004 – 2007*

Thesis title: Investigation into methods to control droplet formation in liquid jet breakup in single and compound jets.
Supervisors: Prof. S. P. Decent & Prof. M. J. Simmons.

University of Birmingham — Birmingham, United Kingdom

M.Sci in Mathematical Sciences (First Class) — *2000 – 2004*

Thesis title: Instability of spiralling liquid jets.
Supervisor: Prof. S. P. Decent.

Career since graduation

Lecturer in Applied Mathematics, (University of Birmingham) *April '10 – Present*
Duties include teaching undergraduate courses in Perturbation Theory, Nonlinear Systems and Chaos and Mechanics. Also research supervision of both Masters level and PhD level students. I currently have **5 PhD students**. As **Director of Admissions**, I am responsible for overall policy and strategy for School admission matters. Duties include leading the Admissions Team and coordinating Applicant Visit Days as well as overall responsibility for marketing.

Visiting Professor, KAUST, Saudi Arabia *September '13 – Jan '14*
Working in the High Speed Fluids Laboratory supervising experiments in cavitation during particle collisions.

Research Fellow in Hydrodynamics, (University of Birmingham) *September '07 – April '10*
Working on developing asymptotic models to capture the behaviour of a free surface near the vicinity of a moving plate and liquid intersection point with applications to ship slamming and dam breaking.

Major Research Interests

1. **Onset of Cavitation and Impact Dynamics:** In collaboration with the High Speed Fluids Lab in KAUST this work is a theoretical/experimental investigation into behaviour observed when particles collide with applications in food manufacturing. The work also addresses some fundamental questions about what occurs at very short time and length scales in a fluid under high shear. Our work is now attempting to unravel the mystery behind whether shear induced cavitation is possible prior to impact in these scenarios - the two competing theories are our own and another European group.

2. **Hydrogen Fuel Cell Modelling:** Appreciating the dynamics of a fuel cell and optimising its output is arguably amongst the greatest challenges in renewable energy research in this century. Together with the DTC in Chemical Engineering at Birmingham I am working on understanding the oscillations in the output of a fuel cell and we have made significant progress in producing a consistent theoretical framework for this process. I have supervised two PhD students on this theme. Moroever, I was the lead researcher to initiate and form links in the area of fuel cell modelling with the School of Engineering at the University of Illinois in Urbana Champagne. In particular I was an invited representative and was instrumental in obtaining funding (of around **£2.5K from the Maths Institute**) for the Head of Department of Chemical Engineering at Illinois Prof. Paul Kenis to visit our University as well as getting the money to support a postdoctoral student Dr. Pedro Lopez-Motenisos from Illinois to spend time at the School of Mathematics.

3. **Free surface flows and Liquid Jets:** My primary work to date involves an examination of the flow structure and dynamics of a liquid thread towards breakup and droplet formation. Most of this work has applications in industrial fertilizer production, pharmaceutics and ink-jet printing.

4. **Modelling blood flow in arteries:** I have been a Visiting Fellow at Universiti Teknologi Malaysia (UTM) during April 2014 where I worked with a leading heart surgeon on stent modelling for coronary heart disease surgery and understanding blood flow in arteries. I have formed a close relationship between myself and academics there and we intend to submit a research grant application in the future on this theme with the express support of Dr Shahrom Ujang at Johur Specialist Hospital and Prof. Sarah Norsuaidah at UTM. I have also visited Universiti Putra Malaysia (UPM) in 2012 where I began an initiative for greater links between our School of Mathematics and the Faculty of Science at UPM. This allowed me to secure funding of **£43K** to support a postdoctoral student to visit our department and work with me for 2 years.

5. **Multilayer curtain coating:** Coating processes have a vast array of applications; from the more traditional practices such as the photographic and film industry to more modern examples such

as in anti-fingerprint applications or hydrophilic coatings applied in medical materials. I am working with colleagues at UEA and KAUST where we have joint PhD student working of liquid curtain coating in both experiments and theory.

6. **Boundary Layer flow over reacting surfaces:** I have been key in forming a relationship with Indian Institute of Technology-Mumbai. I was the **lead organizer** of the first International Symposium on Recent Trends in Applied Mathematics held in Mumbai in November 2011. I organized and successfully completed a three day workshop with 9 members of our department taking part in this initiative. I have built upon my links formed through this process by submitting a number of applications in particular a UKIERI Trilateral Research Partnership bid in Fuel Cell modelling where I exploited my links with the University of Illinois and also academics at Calicut University.

7. **Taylor dispersion in tubes:** Understanding the size of molecules or particles within a given sample of say blood or saliva is critical for biotherapeutic devices. In collaboration with Paraytec Ltd and Malvern Instruments and a **KTN funded project (PI, £9.6K)** I was the lead researcher in a project where we established a theoretical framework for one such device which seeks to efficiently measure particle sizes in small samples using dispersion. This work had direct benefits to improving a device made by Paraytec Ltd for this purpose.

8. **Medical waste disinfection:** I am collaborating with Prof. Erhan Coskun from Karendiz University in Turkey to develop a model for device that consists of concentric cylinders with germicidal UV lamps along the inner and outer walls of the cylinders. The primary aim of this work is to optimise a device for waste disinfection.

9. **Large crowd dynamics:** I have been working with colleagues attached to the Interior Ministry in Saudi Arabia and in particular Dr. AbdulAziz AlJohani, in developing a framework to establish a centre for the modelling of large crowd behaviours during the Hajj season. In particular they are interested in establishing mechanisms to prevent stampedes and also ensure optimum flow of people through key points.

10. **Granular media dynamics:** Granular mediums are common in many industrial and every day settings. Unlike fluids they have more complex flow properties which have prevented progress in gaining an accurate model for how they respond to, for example, impact by a load. I am currently laying the groundwork for collaborative links with Texas Tech University with Dr. Jeremy Marston on a project involving impact on granular media which extends the work we have done together on impact and cavitation.

Awards and Prizes

1. **Excellence in Teaching Award, 2009:** For outstanding teaching and supporting of student learning.

2. **UK-Ireland SIAM Prize, 2006:** Best oral presentation at British Applied Mathematics Colloquium at University of Keele.

3. **Watson Scholarship in Mathematics, 2000:** Distinguished performance in Mathematics.

Principal Research Grants (PI)

1. **£42, 982, Ministry of Higher Education Malaysia, KPT (BS) 781029065188:** Support for Dr. Norfadzillah Mohd Mokhtar to pursue Post Doctoral research on the theme of multilayer curtain coating for a duration of two years.

2. **£10,200, Circles of Influence:** from the Circles of Influence Award Scheme to fund the purchase of Turning Point Clickers to help make lectures more interactive.

3. **£2,500, Maths Institute :** Organising Fuel Cell Conference and visit by Prof. Paul Kenis and Dr. Pedro Lopez-Montenisos from University of Illinois -Urbana Champagne.

4. **£9,000, EPS:** Organising India Workshop on Recent Advances in Industrial Mathematics at IIT-Mumbai.

5. **£9,600, EPSRC/KTN:** Grant to work on Taylor Dispersion in Tubes with Paraytec and Malvern Instruments. This grant allowed for a Post-Doc to work with me for 3 months.

6. **6 fully funded trips** and stays (including sabbatical) at KAUST including flights, accommodation and expenses. Additional support to sponsor student travel to conferences and student visits to High Speed Fluids Lab at KAUST.

Research Supervision: PhD

Over the last 4 years I have been the main supervisor of **4 PhD students** who have all graduated (of which 3 were **international students**). I am the main supervisor of one further student and a co-supervisor of a further 2 students.

1. **Mohammed Mohsin, 2008-2012**, PhD Supervisor, Passed Jan 2012, EPSRC Funded, Thesis title: On Asymptotical and Numerical Analyses of Liquid Jets.

2. **Jamie Sandells, 2009-2013**, PhD Supervisor, Passed on Dec 2013, EPSRC Funded, Thesis title: Mathematical Modelling of Planar Solid Oxide Fuel Cells.

3. **Muhammad Afzaal, 2010-2014**, PhD Supervisor, Passed on September 2014, Funded by Government of Pakistan, Thesis title: Instability of Single and Compound Jets.

4. **Abdullah Al Sharif, 2010-2014**, PhD Supervisor, Passed on Sept 2014, Government of Saudi Arabia Instability of Rotating Viscoelastic Liquid Jets.

5. **Jonathan Sands, 2011-2014**, PhD Co-supervisor, Estimated date of submission is November 2014, DTC in Hydrogen Fuel Cell funded, Thesis title: Modelling Oscillations in Hydrogen Fuel Cells.

6. **Julian Thompson, 2011-2014**, PhD Co-supervisor, Estimated date of submission is November 2014, EPSRC Funded, Thesis title: Instability of Liquid Sheets.

7. **Dominic Henry, 2012-2015**, Supervisor, Estimated date of submission is September 2015, EPSRC Funded, Thesis title: Liquid Curtain Coating and Stability of Multilayer Curtains.

Research Supervision: Postdoctoral

1. **Dr. A. Davies (Jan 2012 - Apr 2012):** Developing a theoretical and computation model for the flow in a tube with concentration dependent viscosity undergoing Taylor Dispersion. Funded by a KTN/EPSRC £9.6K grant.

2. **Dr. P. Lopez-Montesinos (Sept 2011) :** Developing a working model for liquid membrane fuel cells. Funded by Maths Institute, £2.5K.

3. **Dr. N. Mokhtar (Jan 2013 - Jan 2015):** Developing a model for shear thinning multilayer liquid curtains and determining stability criteria. Funded by Malaysian Government Grant, £43K.

Industrial Collaboration

1. **Norsk Hydro and BASF (2004-2008):** Industrial Prilling with applications in the production of fertilizer pellets and breakup of liquid jets. The work with these companies was in connection to an EPSRC grant and then some follow up work. I have 6 A/A* publications related to this work.
2. **Schlumberger (2011-2013):** Rotating disk flow with applications to drilling for oil. This was the focus of a Industrial Study Group Report and also a Masters project.
3. **Malvern Instruments & Paraytec Ltd (2012):** Dispersion in Microtubes and Taylor dispersion with applications to sample analysis along with microanalysis and development of TDA2000 device. This was part of a KTN/EPSRC £9.6K postdoctoral studentship. A Industrial Case Report was produced.
4. **Pall Coorporation (2014):** Oxford Study Group interaction on air filter design and modifications.

Teaching Experience

1. **Teaching Assistant (2004-2007):** For a wide range of courses including computational mathematics where the use of specialist mathematics software was required including Maple and MATLAB. Duties included one-to-one support and small group teaching.
2. **Perturbation Theory (Programme Leader 2009-2013):** Full responsibility for this 10 credit module. This is an optional 3/4 Year Module with student numbers on this module on average around 50 during my teaching which is significantly higher than in the years before and after my teaching. I was awarded an Excellence in Teaching Award for my first year of teaching this module due to the innovative nature and style of my teaching. Duties included designing the module syllabus and writing a set of course notes which reflected the use of this method in modern engineering and science applications. The setting of problem sheets and exams was also administered by myself.
3. **Chaos (Programme Leader 2011-2013):** I have taught Chaos which is a 10 credit module from 2010 till 2012. This is an optional 3/4 Year Module with approximately 30 students on the course. The use of computational and other visual resources was an innovative aspect of my teaching during this course
4. **Mechanics (Programme Leader 2013-Present) :** I have been teaching Mechanics to Year 1 student since this year. As it is a compulsory first year course the demands a lot more and with student numbers around 250 there is a need for a variety of teaching methods and techniques to get the best out of students. This module was designed and developed by myself from scratch as the it was part of the first year curriculum review in 2013 and as such was created to accommodate students needs.

Management Experience

1. **Director of Admissions (Sept 2013 - Present):** I have been in this role for just over a year and I believe I have made a strong contribution to the School through this role. Building on my role within Admissions in previous years we have **increased applications** (up 42% from last year), **increased student numbers** (15% increase from 2012) and **improved the average tariff** (going from 459 in 2013 to 490 this year) of our cohort in an environment when our competitors have fallen back. We have also enjoyed our best Guardian League Table position of 4^{th} this year which builds upon our consistent top 10 positions over the last few years. My main role comprises of
    - Supervising and Coordinating the Admissions Team to work harmoniously with the targets and goals set by the University and College and our aim of ensuring the highest calibre students are admitted onto our programme. We have over 1400 applications each year of which we manage to convert approximately half of those to select us as Firm or Insurance.

- Formulate and implement recruitment strategies which optimise recruitment of high quality students from Home, EU and international markets.
- Develop strategies for coping with fluctuations in recruitment cycles and algorithms which inform decision making in terms of offers and adjustments.
- Responsibility for confirmation process during August.
- Developing a strategy and vision for the School of Mathematics in terms of Admissions which is central to the School's sustainability and growth. Liaising with the Head of School to formulate and devise strategies to improve potential of AVDs and Open Days.
- Represent the School at Outreach Events and present talks and Master Classes to local Schools and Colleges.
- Oversee changes and developments in the Marketing of the School which includes the School brochure and webpages and other material distributed during Open Days and AVDs.

2. **Admissions Tutor (June - Sept 2013) :** I was in this role for a short time but was instrumental during the busiest period of that Admissions cycle. In particular, the Open Days were a huge success leading to a record year in applications. I was then promoted to Director of Admissions.
3. **International Officer (April 2011 - Sept 2012:** In this role I was involved heavily with the School's initiatives with China in developing our joint programmes. I was also the lead organiser of an International Conference in India with many members of staff from the School of Mathematics involved. Towards the end of this period I was part of a bid to organise a workshop between Birmingham and Nottingham academics in Brazil.

International Invited Talks

1. Departmental Seminar, 'Industrial fluid mechanics,' 14 April 2012, **Universiti Putra Malaysia**.
2. International Symposium in Applied Mathematics, 'Free Surface Flows: Theory and Computation,' 8th November 2011, **Indian Institute of Technology in Mumbai**.
3. Departmental Seminar, 'Initial development of a free surface near an accelerating plate,' 23rd April 2011, **King Abdullah University of Science and Technology in Saudi Arabia**.
4. Departmental Seminar, University of Illinois, 'Fuel Cell Modelling', 8th July 2010, **University of Illinois in Urbana-Champagne**.

National Invited Talks

1. **University of Dundee**, Departmental Seminar, 'Liquid Curtain Coating,' June 12th 2014.
2. BAMC Mini-Symposium Invited Speaker, 'Initial development of a free surface near an accelerating plate,' **University College London**, 27th March 2012.
3. **University of Oxford,** Departmental Seminar, 'Industrial applications of Liquid Jets,' 1st March 2012.
4. **University College London,** Departmental Seminar, 'Industrial applications of Liquid Jets,' 27th Jan, 2012.
5. **University of Keele,** Hydrodynamics Stability Meeting, 'Electrokinetic flow in tubes,' 14 Feb 2011,
6. **University of Leeds,** IMA Fluids Processes in Industry Workshop, 'Electrokinetic flow in tubes,' 3rd September 2010.
7. **University East Anglia,** Departmental Seminar, 'Free surface deformation near a plate' 25th Jan, 2010.

External Examiner

1. **PhD External for Paul Towers**, "The stability and transition of the compressible boundary-layer flow over broad rotating cones", July 2013, University of Leicester.
2. **PhD Examiner for Peter Deacon**, "Hydroelastic stability and wave propagation in fluid filled channels", Aug 2014, University of East Anglia.
3. **Panel Member for Midlands Energy Consortium** Panel member alongside Prof. M. Schroeder and Prof. S. Christie to allocate 8 PhD studentships under Midlands Energy Consortium (MEC) funding.

Wider Contribution

1. **Outreach Events:** I take part in various outreach events and activities especially with local inner city schools
2. **Equality and Diversity Committee:** I am an active member of this committee.

List of Publications : Peer Reviewed Articles

1. 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.
2. 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.
3. J. Uddin, S. P. Decent and M.J. Simmons, (2008), **'Non-linear waves along rotating non-Newtonian liquid jets,'** Int. J. Eng. Sci., **46**, 12, 1253-1265.
4. J. Uddin and S. P. Decent (2009), **'Curved non-Newtonian liquid jets with surfactants,'** J. Fluids Eng., **131**, 901203.
5. S. P. Decent, A. C. King, M. J. H. Simmons, E. I. Parau, C. J. Gurney and J. Uddin, (2009), **'The trajectory and stability of a spiralling liquid jet: viscous theory,'** Applied Mathematical Modelling, **33**, 4283-4302.
6. J. Uddin and S. P. Decent (2009), **'Non-Newtonian jets curved by gravity,'** Mathematics in Industry (2008), Springer.
7. V. Hawkins, C. J. Gurney, S. P. Decent, M. J. H. Simmons and J. Uddin, (2010), **'Unstable waves on a curved non-Newtonian liquid jet,'** J. of Phys. A, **43**, 055501.
8. J. Uddin & S. P. Decent, (2010), **'Breakup of compound liquid jets falling under gravity,'** J. of Phys. A. **43**, 485501.
9. J. Uddin & S. P. Decent, (2012), **'Drop formation in rotating non-Newtonian jets with surfactants,'** IMA Journal of Applied Mathematics, **77**, 1, 86-96.
10. M. Mohsin, J. Uddin, S. P. Decent & M. J. H. Simmons, (2012), **'Breakup and droplet formation in shear thinning compound liquid jets,'** IMA Journal of Applied Mathematics, **77**, 1, 97-108.
11. J. Uddin, J. O. Marston and S. T. Thoroddsen, (2012), **'Squeeze flow of a Carreau Fluid,'** Phys. Fluids, **24**, 073104.
12. M. Mohsin, J. Uddin, M. Afzaal and S. P. Decent, (2013), **'Temporal Instability Analysis of Inviscid Compound Jets Falling Under Gravity,'** Phys. Fluids, **25**, 012103.

13. M. Mansoor, J. Uddin, J. O. Marston and S. T. Thoroddsen, (2014), **'The onset of cavitation during the collision of a sphere with a wetted surface,'** Exp. in Fluids, 55:1648.

14. J. D. Sands, D. J. Needham, J. Uddin, (2014), **A Fundamental Model Exhibiting Nonlinear Oscillatory Dynamics in Solid Oxide Fuel Cells,'** Proceedings of the Royal Society A, 470, 2164, 20130551.

15. J. D. Sands, D. J. Needham, J. Uddin, (2014), **Nonlinear Oscillatory Dynamics in Solid Oxide Fuel Cells,'** The Electrochemical Society Transactions, 57, 2617-2626

16. J. O. Marston, S. T. Thoroddsen, J. Thompson, M. Blyth, D. Henry & J. Uddin, (2014), **'Experimental investigation of hysteresis in the break-up of liquid curtains,'** Chem. Eng. Sci., **117**, 248-263.

List of Publications: Peer Reviewed Conference Proceedings

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

2. A. Alsharif & J. Uddin, (2013), **'The Influence of Gravity on The Temporal Instability of Viscoelastic Liquid Curved Jets',** World Academy of Science and Technology, Turkey.

3. J. Sands, D. J. Needham and J. Uddin, (2013), **'Nonlinear Oscillatory Dynamics in Solid Oxide Fuel Cells**', Solid Oxide Fuel Cells XIII, Okinawa, Japan, 2613-2623.

List of Publications: In Press

1. J. O. Marston, S. T. Thoroddsen, J. Thompson, M. Blyth, D. Henry & J. Uddin, (2014), **'Multi-layer film flow down an inclined plane: Experimental investigation,'** Exp. in Fluids.

List of Publications: Submitted

1. J. Uddin and D. J. Needham, (2014) **'Free surface interaction with an accelerating plate,'** Journal of Fluid Mechanics.

2. D. Henry, J. Uddin, J. O. Marston, S. T. Thoroddsen, (2014), **'Stability of an unsupported multi-layer surfactant laden liquid curtain under gravity**', Phys of Fluids.

References

See Application Form
