

## RAHIL VALANI

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### EDUCATION

- Doctor of Philosophy in Physics/Applied Mathematics** 2017 – 2020  
Monash University  
**Thesis title:** Superwalking Droplets and Generalised Pilot-Wave Dynamics
- Dual Degree: Bachelor of Aerospace Engineering (Honours) and Bachelor of Science** 2012 – 2016  
Monash University  
**Majors:** Aerospace Engineering, Physics, Mathematics GPA/WAM=3.861/86.879  
**Thesis title:** A numerical study of flow past a forced oscillating circular cylinder at low Reynolds number

### LIST OF PUBLICATIONS

- **Rahil N. Valani.** *Lorenz-like systems emerging from an integro-differential trajectory equation of a one-dimensional wave-particle entity*, Chaos 32, 023129 (2022). <https://doi.org/10.1063/5.0076162>
- **Rahil N. Valani.** *Anomalous transport of a classical wave-particle entity in a tilted potential*, Physical Review E (Letter) 105, L012101 (2022). <https://doi.org/10.1103/PhysRevE.105.L012101>
- **Rahil N. Valani,** David M. Paganin, A.C. Slim, T. Simula and Theodore Vo. *Unsteady dynamics of a classical particle-wave entity*, Physical Review E 104, 015106 (2021). <https://doi.org/10.1103/PhysRevE.104.015106>
- **Rahil N. Valani,** A.C. Slim and T. Simula. *Stop-and-go locomotion of superwalking droplets*, Physical Review E, 103, 043102 (2021). <https://doi.org/10.1103/PhysRevE.103.043102>
- **Rahil N. Valani,** Jack Dring, Tapio P. Simula and Anja C. Slim, *Emergence of superwalking droplets*, Journal of Fluid Mechanics **906**, A3 (2021). <https://doi.org/10.1017/jfm.2020.742>
- **Rahil N. Valani,** Anja C. Slim, Tapio P. Simula, *Superwalking Droplets*, Physical Review Letters **123**, 024503. (2019). <https://doi.org/10.1103/PhysRevLett.123.024503>
  - Focus story published in APS Physics <https://physics.aps.org/articles/v12/80>
  - Media article published in phys.org <https://phys.org/news/2019-07-droplets-liquid-surface.html>
  - Media article published in physicscentral.com <https://www.physicscentral.com/buzz/blog/index.cfm?postid=5353019309395046474>
- **Rahil N. Valani,** Anja C. Slim, *Pilot-wave dynamics of two identical, in-phase bouncing droplets*, Chaos **28**, 096114 (2018). <https://doi.org/10.1063/1.5032128> (Editor's pick)
- **Rahil N. Valani,** Anja C. Slim, Tapio P. Simula, *Hong-Ou-Mandel-like two-droplet correlations*, Chaos **28**, 096104 (2018). <https://doi.org/10.1063/1.5032114>
- **Rahil N. Valani,** Andrew J. Groszek, Tapio P. Simula, *Einstein-Bose condensation of Onsager Vortices*, New Journal of Physics **20**, 053038 (2018). <https://doi.org/10.1088/1367-2630/aac0bb>

### AWARDS and PRIZES

- Robert Street Doctoral Prize** for best PhD thesis 2021  
School of Physics and Astronomy, Monash University
- T.M. Cherry award** for best student presentation at ANZIAM conference 2021
- Postgraduate Publication Award** by Faculty of Science, Monash University 2020  
Awarded \$5000 for preparation and publication of PhD research

<b>2020 Norris Family Award</b> for Outstanding Research Output by a Graduate Research Student Faculty of Science, Monash University	2020
<b>Runner-up</b> for 3-minute thesis (3MT) competition in the Faculty of Science, Monash University	2019
<b>'Best student presentation award'</b> at the 8 <sup>th</sup> Meeting on Hydrodynamics Quantum Analogs Brown University, Rhodes Island, USA	2018
<b>JL William Postgraduate Top Up Scholarship</b> \$5000 (AUD) per year, awarded to high achieving PhD students	2017
<b>Best in School Award</b> – School of Physics and Astronomy at Monash University Awarded for achieving highest score in 3 <sup>rd</sup> year Physics undergraduate units	2016
<b>Dean's List for Outstanding Academic Achievement</b> Awarded for 4 consecutive years, awarded to students achieving an average of 85% or above in that year	2012-16
Australian Mathematical Science Institute (AMSI) <b>Summer Research Scholarship</b> Awarded \$500(AUD) per week for 6 weeks to undertake a summer research project	2015

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## CONFERENCE PRESENTATIONS & TALKS

<b>Anomalous transport of a classical wave-particle entity</b> ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	10 <sup>th</sup> Feb 2022 Virtual
<b>Bifurcations and dynamics in inertial focusing of particles in curved rectangular ducts</b> ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	7 <sup>th</sup> Feb 2022 Virtual
<b>Bifurcations in inertial focusing of particles in curved rectangular ducts</b> 16th International Conference on Dynamical Systems Theory and Applications (DSTA)	9 <sup>th</sup> Dec 2021 Virtual
<b>Superwalking droplets</b> ANZIAM (Australian and New Zealand Industrial and Applied Mathematics) Annual Conference	1 <sup>st</sup> Feb 2021 Virtual
<b>Stop-and-go motion of Superwalking droplets</b> Statistical Mechanics of Soft Matter Meeting	14 <sup>th</sup> Dec 2020 Virtual
<b>Emergence of Superwalking droplets</b> 73rd Annual Meeting of the American Physical Society's Division of Fluid Dynamics	24 <sup>th</sup> Nov 2020 Virtual
<b>Superwalking droplets</b> Statistical Mechanics of Soft Matter Meeting	17 <sup>th</sup> Dec 2019 University of Adelaide, Adelaide, Australia
<b>Superwalking droplets</b> Australian Institute of Physics Summer Meeting	6 <sup>th</sup> Dec 2019 RMIT, Melbourne, Australia
<b>Superwalking droplets</b> 72nd Annual Meeting of the American Physical Society's Division of Fluid Dynamics	26 <sup>th</sup> Nov 2019 Seattle, USA

## Superwalking droplets

Fluids Seminar Series

7<sup>th</sup> May 2019

Monash University, Melbourne, Australia

## Many droplet dynamics and superwalkers

8<sup>th</sup> Meeting on Hydrodynamic Quantum Analogs

24<sup>th</sup> Jul 2018

Brown University, Providence, Rhode Island, USA

## Many-droplet Hydrodynamic Quantum Analogs

Victorian ULtraCold Atoms Network (VULCAN) Workshop

22<sup>th</sup> Sep 2017

Swinburne University, Melbourne, Australia

## Einstein-Bose Condensation of Onsager Vortices

Conference on Optics, Atoms and Laser Applications (KOALA)

27<sup>th</sup> Nov 2016

Monash University, Melbourne, Australia

## A Numerical Study of Flow past a Forced Oscillating Cylinder

American Institute of Aeronautics and Astronautics (AIAA) Student Conference

21<sup>st</sup> Nov 2016

Melbourne, Australia

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## MENTORING

- *Jack Dring – Summer research project undergraduate student – Monash University – July 2019*
  - Worked on experiments of superwalking droplets and theoretical modelling of bouncing and walking droplets. This work led to a publication in the Journal of Fluid Mechanics
- *James Day – Summer research project undergraduate student – University of Adelaide – Dec 2020/Jan 2021*
  - Worked on integrability of Lorenz-like dynamical systems emerging from the walking-droplet system and investigating a wave-particle entity in a harmonic potential
- *Joshua Perks – Summer research project undergraduate student – University of Adelaide – Jan 2021/Feb 2021*
  - Worked on dynamics and stability of a wave-particle entity in a sinusoidal potential

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## PROFESSIONAL RESEARCH WORK EXPERIENCE

University of Adelaide - Adelaide, SA

Feb 2021 - Current

### ARC Grant Funded Postdoctoral Researcher

#### Key Responsibilities:

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- Undertaking cutting edge research in mathematical analysis of particle dynamics in fluid flows inside curved ducts using analytical and computational tools. ***This research will have potential application in 'liquid biopsy' – the isolation of circulating tumor cells (CTCs) from blood samples***
- Communicate the research outputs by publishing in high impact international journals and presenting at both national and international conferences

AMOG Consulting - Melbourne, VIC

Jun 2016 - Jul 2016

### Vacation Student Engineer

#### Key Responsibilities:

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- Developing flow charts to understand data flow of a cable simulator software
- Understanding and implementing analytical models for a cable/strand under tension and bending loads

- Investigating analytical models for enhancing wave energy production and performing numerical analysis in MathCAD and MATLAB
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**School of Mathematical Sciences - Monash University, Clayton, VIC**

**Jun 2015 - Feb 2017**

### **Research Assistant**

#### **Key Responsibilities:**

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- Developing a mathematical model to perform quantitative study of a dynamical system of two bouncing droplets on a vibrating bath
  - Working independently to analyze the numerical results obtained from MATLAB and verifying with analytical approximations and experiments
  - Using effective communication skills to convey the work to colleagues and academics through clear explanations of unfamiliar concepts during group meetings
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## **PROFESSIONAL TEACHING EXPERIENCE**

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**Monash College - Melbourne, VIC**

**Feb 2019- Dec 2020**

### **Teaching Professional**

**Courses:** MCD4160 – Physics for Engineering, MCD1200 – Physics A

#### **Key Responsibilities:**

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- Teaching Physics and Engineering to a class of diverse senior international diploma students
  - Conducting Lab session where I guide students in performing Physics experiments and help them connect the theoretical concepts to hands-on experiments
  - Occasionally conducting lectures and tutorials where I teach them theoretical concepts in Physics and Engineering
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**Monash University - Melbourne, VIC**

**Mar 2017 – Dec 2020**

### **Teaching Assistant**

**Courses:** ECE3093 – Optimisation, Estimation and Numerical Methods (*Semester 1 – 2019*), MTH3360 – Fluid Dynamics (*Semester 1 – 2017 and 2018*) and PHS2061 and PHS2062 – 2<sup>nd</sup> year Physics (*Semester 1 and 2 – 2017*)

#### **Key Responsibilities:**

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- Reviewing content covered in lectures and concepts that the students are struggling with
  - Identifying students' learning gaps and assisting them in understand and applying the concepts learned in lecture to solve problem set
  - Giving feedback to students on their work and help them become independent learners
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**Teach Me Tutoring - Melbourne, VIC**

**Feb 2017- Current**

### **Mathematics/Physics Tutor**

#### **Key Responsibilities:**

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- Assisting students one-on-one with high school Mathematics and Physics
  - Explain concepts to students and identifying and addressing their learning gaps
  - Help them develop good study habits and assist them in becoming independent learners
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## **VOLUNTARY WORK AND EXTRA-CURRICULAR ACTIVITIES**

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**Various roles - Community Centre, Vermont, Melbourne, VIC**

**2017 - Current**

**Conducted Science Workshops for primary school students at the local community center.**

- Create hands-on experiments and engaging content every second school holidays for these students.
  - Train youth volunteers to assist in conducting this session.
  - Managing the full program by working effectively with different teams
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**Mathscraft workshops**

**2021 - Current**

**Assisted as a Mathematician at the workshop to provide school maths teachers an experience of doing maths like a research mathematician**

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