

**Current Role:**

Postdoctoral research fellow in the Device Research Laboratory MIT

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**Proposed Research Topic / Purpose of Visit**

Marie Skłodowska Curie Postdoctoral Global Fellowship

**Title:** Passive Solar Evaporators for Green Desalination Technologies

**Acronym:** SEAFRONT

## Curriculum Vitae

Name: Dr. Joseph Phelim Mooney (BSc, MSc, PhD)

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**Profile Summary:** ♦ **5 Peer-reviewed scientific publications (2 published, 2 accepted, 1 under review) in high impact journals during my Ph.D.**

**What this shows:** An ambitious early-stage researcher, high-level of originality and productivity, scientific excellence, high-level of interdisciplinary ability, capacity to disseminate results for the benefit of *science and society*.

**What this means:** Team oriented with coordination ability, strong commitment to research and scholastic ability, high capacity to make significant impact in the field, and value for money oriented

♦ **Winner of prestigious and competitive research awards and prizes**

**What this shows:** Capacity to succeed disseminate to broad audience, ability to influence, and high level of commitment to success

**What this means:** Results oriented, high level of innovation and persuasion, and determination to reach the highest level

♦ **Serving excellently in various capacities as a leader and mentor**

**What this shows:** Strong leadership skills, commitment to improve education, services to society and peace coordinator

**What this means:** Results oriented with high-level of creativity and innovation, strong commitment and selflessness

### A. PROFESSIONAL EXPERIENCE

Approved 2022:2026 **Marie Skłodowska Curie Global Fellowship** (Mentor: Prof. Evelyn Wang, MIT, Prof. Jeff Punch and Dr. Vanessa Egan, UL). *Device Research Lab, School of Mechanical Engineering, Massachusetts Institute of Technology and Bernal Institute, University of Limerick.*

- Project: Passive Solar Evaporators for Green Desalination Technologies.
- 99.2% Grade and second in its category in the Marie Skłodowska Curie Actions 2021/22.
- In collaboration with Massachusetts Institute of Technology I will be developing and demonstrating high-efficiency passive solar-water desalination/ purification devices by gaining an in-situ non-invasive insight into the underlying physics of the state-of-the-art materials and devices.
- This work will be applicable to both developed and developing regions where I will be trained in transferrable skills such as, entrepreneurship, climate action, gender equality, communication, business, mentoring and supervision.

01/11/21: 01/11/22 **Post-doctoral Researcher** (Mentor: Prof. Seamus O'Shaughnessy, Prof. Anthony Robinson. *Industrial Partner: Huawei Technologies Co., Ltd.) Fluids & Heat Transfer Research Group, Department of Mechanical, Manufacturing & Biomedical Engineering, School of Engineering, Trinity College Dublin, Dublin.*

- Two-phase heat transfer, capillary driven evaporation, and wicking structures.
- Working on a team of 5 Principal Investigators and 4 postdoctoral researchers.
- Industry-facing project to develop and characterise novel high-performance wicking materials for anti-gravity liquid circulation in emerging electronics applications. The focus of this post will be on (i) the thermal characterisation of an existing technology from the industry partner, (ii) the design, construction and commissioning of fluid and thermal characterisation facilities for wicking structures, and (iii) the carrying out of a series of experiments using these rigs, as well as the reporting and analysis of the results from the experiments to the industrial partner fortnightly.

28/09/2021– 31/10/21: **Post-doctoral Researcher** (*Mentors: Prof. Jeff Punch & Dr. Vanessa Egan*) *School of Engineering, University of Limerick, Limerick, Ireland*

- Researching on novel capillary structures for maximised heat transfer performance, thermal modelling of porous conductive networks, developing novel hydraulic resistance models for x-ray tomography datasets, and preparing publications.
- Mentoring research activities of undergraduate and master students and writing of MSCA research grant proposal.

01/10/2018 – 31/05/2021: **Teaching Assistant** (Part-Time)  
*School of Engineering, University of Limerick, Limerick, Ireland*

- Taught modules in fluid mechanics, computer programming and heat transfer totalling >300 college students.
- Offered mechanics, dynamics, fluid mechanics, heat transfer, and thermodynamics tutorials to > 100 undergraduate students.

01/10/2018 – 31/02/2020: **Laboratory Assistant** (Part-Time)  
*School of Engineering, University of Limerick, Limerick, Ireland*

- Coordinated several laboratory activities for practical modules (fluid Mechanics, computer programming and heat transfer) to over 80 students.

01/05/2016 – 01/09/2016: **Co-operative Industrial Education** (Full-Time)  
*Johnson & Johnson Visioncare (J&J), Limerick, Ireland*

- Energy and Mechanical Engineer for the facilities department at J&J.
- Project execution on water management strategies to meet LEED certification.
- Monitoring factory energy consumption and raising awareness in climate action.
- Identifying and mitigating factors to increase production efficiency, from pneumatic and inert chamber leakage on the production lines to ongoing maintenance of cite water feeds (i.e., water towers, pump filters, and boilers).

09/01/2018 – 10/02/2018: **Industrial Placement** (Part-Time)  
*Nokia Bell Laboratories, Dublin, Ireland*

- Thermal solutions department: Learned how to design, manufacture and test cooling solutions, in particular heat pipes.
- Learned fabrication skills in laser cutting, degassing of liquids for two-phase heat transfer applications, and polymer 3D printing with water-soluble support materials.

## **B. EDUCATION**

01/10/2018 – 28/09/2021: **PhD in Mechanical Engineering**  
*Institution:* University of Limerick, Ireland (*Advisors:* Dr. Vanessa Egan & Prof. Jeff Punch)  
*Topic:* *On the Thermo-fluidic Behaviour of Deformed Multi-Source Heat Pipes*

01/10/2018 – 16/11/2019: **M.E. in Mechanical Engineering**  
*Institution:* University of Limerick, Ireland (*Advisors:* Dr. Vanessa Egan & Prof. Jeff Punch)  
*Topic:* *Masters Transfer – On the Thermo-fluidic Behaviour of Deformed Multi-Source Heat Pipes*

01/10/2018 – 16/11/2019: **B.Eng. in Mechanical Engineering** (*Advisor:* Dr. Vanessa Egan)  
*Institution:* University of Limerick, Ireland (*Advisors:* Dr. Vanessa Egan, Mr. Niall White)  
*Topic:* *Design of a Lightweight Wireless Metal Gaming Mouse* (Logitech Ireland and Logitech Switzerland)

## **C. PUBLICATIONS**

1. **Joseph P. Mooney**, Jeff Punch, Nick Jeffers, Vanessa Egan, Experimental Thermal and Fluid Science (2021), *An accurate calorimeter-based method for the thermal characterization of heat pipes.*  
*Scientific significance:* *This paper targets the improvement of the measurement standards for heat pipe characterisation, drawing attention to inaccuracies and areas for improvement in the literature.*
2. **Joseph P. Mooney**, Vanessa Egan, Ruairi Quinlan, Jeff Punch, 2020 19th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm), *Effect of Multiple Heat Sources and Bend Angle on the Performance of Sintered Wicked Heat Pipes.*

**Scientific significance:** A novel experimental investigation into the application of bent heat pipes used to cool multiple heat sources and a demonstration into the effects of changing the bend location on thermal performance.

3. **Joseph P. Mooney**, Vanessa Egan, Ruairi Quinlan, Jeff Punch. IEEE Transactions on Components, Packaging and Manufacturing Technology (2021), *Analysis of Sintered Wicked Heat Pipes for Space Constrained Multiple Component Cooling*.

**Scientific significance:** Demonstrating the significance of the microelectronic integration of deformed sintered wicked copper heat pipes to cool multiple heat sources and its impact on the fluid transport mechanisms that degrade thermal performance.

4. **Joseph P. Mooney**, Pat Walsh, Jeff Punch, Vanessa Egan, International Journal of Heat and Mass Transfer, A Capillary Flow Model for Discretely Graded Porous Media. **Open-access.**

**Scientific significance:** An accurate prediction model for imbibition within homogeneous and discretely graded porous media. A demonstration that discretely graded wicks can enhance liquid-flux rates in scenarios where dry out limits their operation (i.e., gravity opposed or multiple heat source cooling) and a use case for the publication's analytical model.

5. **Joseph P. Mooney**, Vanessa Egan, Jeff Punch. Applied Thermal Engineering (2021), A Novel Non-Destructive Methodology for the Analysis and Optimization of Deformed Heat Pipes. **Open-access.**

**Scientific significance:** The application of x-ray computed tomography for characterising the topology of heat pipes and the morphology of their wicking microstructures. The publication also demonstrates the significance of the technique for revealing the change in microstructures when a heat pipe is deformed and how it can be applied to a thermofluidic model to understand the experimental thermal performance degradation.

6. A Elkholy, J Durfee, **JP Mooney**, AJ Robinson, R Kempers. Measurement Science and Technology (2023) A rate-of-rise facility for measuring properties of wick structures.

**Scientific significance:** This study presents a precision experimental test facility that monitors the imbibition of a working fluid in porous media for a multitude of engineering applications.

7. Noel O'Sullivan, **Joseph Mooney**, David Tanner. Journal of the European Ceramic Society (2021), *Enhancing Permeability and Porosity of Ceramic Shells for Investment Casting through Pre-wetting*. **Open-access.** Contribution: X-ray tomography, image processing, numerical modelling, and Pore Network Modelling of sample data for experimental validation and identifying root-cause of hydraulic performance enhancement.

**Scientific significance:** Demonstrating the enhanced permeability of ceramic shells for investment casting through pre-wetting. Using pre-wetting to reduce unintentional heterogeneities such as bulging, excess metal, gas-holes, and delamination in ceramic shells. Improving fluid pathways for enhanced evaporation to occur during the timely drying and final drying process, while aiding the flow of fluids in de-waxing during casting.

8. **Joseph P. Mooney**, Jeff Punch, Vanessa Egan – Doctoral Thesis (2021).

## PUBLISHED WEB ARTICLES

- Journal of Engineers Ireland: Joseph Mooney, winner of the 23rd Annual Sir Bernard Crossland Symposium, on using X-ray tomography and pore network modelling to improve the effectiveness of electronics cooling solutions – “A novel, non-destructive methodology for the optimisation of deformed heat pipe structures”.  
**Audience:** Over 25,000 professionals from every discipline of engineering.
- Silicone republic: Developing sustainable tech to deal with a growing global water crisis.
- Water News Europe: “I am passionate about decoupling water and energy”.
- European Junior Water Programme: Reflections on EJWP4 Week in Athens & Development Value for Academics

## PROJECTS

- U.S. Department of Energy: Energy Efficiency & Renewable Energy - High Energy Density Hydrogel Thermo Adsorptive Storage.

## CONFERENCES

- Micro and Nanoscale Phase Change Phenomena, Gordon Research Conference.
- Building Technologies Office Peer Review

- Micro Flow and Interfacial Phenomena
- 2020 19th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm). *\*Conference was virtual due to COVID-19 Pandemic.*
- EUROTHERM 2020 *\*Conference was cancelled due to COVID-19 Pandemic.*
- Trinity CONNECT Summer School on Machine Learning and Artificial intelligence for network management, link establishment and optimization and the Internet of Things.

## PRESENTATIONS

- 2020 19th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems.
- 23<sup>rd</sup> Engineers Ireland and Council of Professors of Mechanical Engineering, Sir Bernard Crossland Symposium.
- Trinity Tangent Program on Environmental Entrepreneurship “climate innovation/ entrepreneurship in a research context”
- Marie Skłodowska-Curie Actions: Experience and Tips on Writing a Successful Proposal
- John Cabot University “Triggering Change program: Sustainable Solar-Water Purification Technologies”
- Process Engineering Cluster Bernal Institute, and three Stokes Laboratories colloquia, UL.
- Bernal Research Day Postgraduate Research Presentation.
- University of Limerick Open day for Secondary School Students. Final Year project entitled “Design of a Lightweight Wireless Metal Gaming Mouse”.

## REVIEWER OF JOURNALS

- Heat Transfer Engineering.
- IEEE - Transactions on Components, Packaging and Manufacturing Technology.

## PRIZES AND AWARDS

- Prestigious award in All-Island Engineers Ireland & Professors of Ireland in Mechanical Engineering, 23<sup>rd</sup> Sir Bernard Crossland Symposium: Best Research Paper and Presentation Award, Dublin City University, Ireland, December 2020 (€1200).
- University of Limerick Bernal Institute research presentation Award, University of Limerick, Ireland, (€300).
- School of Engineering Research Paper and Presentation Award University of Limerick, Ireland, (€100).

## FUNDING RECEIVED SO FAR

- Marie Skłodowska Curie Global Fellowship €278,571.35.
- Science Foundation Ireland CONNECT Centre Ph.D. award, €120,000.
- Post-doctoral position with Trinity College Dublin and industrial partner, Huawei Technologies Co., Ltd. €41,000.
- Student Athlete (Swimming and Surf-Lifesaving) Undergraduate Scholarship, €10,000.

## EXAMPLES OF PARTICIPATION IN INDUSTRIAL INNOVATION

- *Energy:* As part of an Energy and Mechanical Engineering project in J&J, I worked on compressed air (CA) and Nitrogen functionality in pneumatic robotic control chambers. The objective was to reduce the pressure drop caused by leakage from the containment farms to the production lines and resulted in an estimated €80 - €100k saving in energy and resources per annum. As a result of my research, findings, solutions, and savings to the energy and maintenance engineering department, where I was awarded the title of ‘**Energy Champion**’.
- *Water Sustainability:* To achieve U.S. Green Building Council’s LEED certification I actively participated in and led an industrial project in Johnson & Johnson on water sustainability. The project involved monitoring the plant’s water usage from the office level to the production lines and developing innovative solutions to reduce water waste.

- *Climate Change Awareness Campaign:* I co-organised site tours, presentations, and activities to raise awareness in climate action in Johnson & Johnson and award employees for reaching the plant's climate action goals. I also made a web page for the employees at Johnson & Johnson, including new company achievements in energy, the company's green energy usage and best practices for personal energy management.
- *Logitech Performance* (September 2018 – June 2019): I completed my undergraduate dissertation with Logitech, an international IT hardware and software. The specified aim of the project was to research, design, and manufacture a lightweight, wireless metal gaming mouse for professional computer gamers. The project was also run-in other colleges across Ireland. The prototype I designed, fabricated, and tested outperformed Logitech's best gaming mice at the time. My project was selected as the best in the country, where I was offered an employment contract.

## MEMBERSHIPS

IEEE, IEEE Young Professionals, and Engineers Ireland.

## INDUSTRIAL COLLABORATIONS

- *Stakeholders:* The CONNECT Centre and Science Foundation Ireland – Ph.D. research project, presentation at the summer schools, presentation at CONNECT's site review, participation in social media communication activities.
- *Industrial partners:*
  - Huawei Technologies Co., Ltd. – Post-doctoral Research project (01/11/21)
  - CRANN Lab Trinity College Dublin
  - Nokia Bell Laboratories – hosted an industry visit to my lab, two remote presentations, and took part in a short stay at Nokia's facility for industrial experience;
  - Enovus Labs – collaboration on first author research publication;
  - HARVEST Systems Inc. – Collaboration on academic research;
  - Johnson and Johnson – Industrial placement working as an energy and facilities engineer; and
  - Logitech – Research project on the design of a lightweight, high performance, professional metal gaming mouse.

## SUPERVISION AND MENTORING ACTIVITIES

- *As a PhD candidate:* I mentored 4 master, 2 undergraduate, and 4 summer research students on the practical and theoretical aspects of passive thermal management strategies for electronic components and EV car batteries, leading to > €20,000 in undergraduate research funding and co-authored conference and research papers (e.g., Publication 2, 3, \*other conference and research publications were delayed due to the COVID-19 Pandemic). Project Titles:
  - *Experimental Investigation on the Effect of Multiple Heat Sources and Bend Angle on the Performance of Sintered Wicked Heat Pipes* (Summer Research Student).
  - *Design of Multi-Porous Wicks for Enhanced Heat Pipes* (Summer Research and master's Student)\*.
  - *A Finite Element Investigation into The Thermo-Fluidic Performance of Sintered Wicked Heat Pipes for Space Constrained Multiple Component Cooling* (Summer Research Student).
  - *Analysis of a Battery Thermal Management System for Electric Vehicles Using Heat Pipe Technology.* (Masters Student)\*.
  - *A Multi-Branch Heat Pipe Thermal Management System for Electric Vehicles* (Summer Research and master's Student).
- *As a Teaching Assistant:* I offered tutorials in fluid mechanics, heat transfer, and computer programming, to over 200 first- and second-year college students preparing for their exams.
- *Private Classes:* I offered Grinds in fluid mechanics, heat transfer, mechanics, dynamics and thermodynamics and hosted a grind school for undergraduate students the week before final exams.

## OTHER ITEMS OF INTEREST

### Core Hands-on Research and Analytical Skills Relevant to the Project:

- *Synthesis:* Fabrication of porous materials in ambient and inert environments, Micro-Interface Engineering, moulding of polymer structures, precision vacuuming of fluids for two-phase heat transfer, degassing fluids, resin printing, polymer and metal 3D printing.
- *Experimental Techniques:* Imbibition in heterogeneous and graded porous media, Calorimetry\*, thermal characterization of two-phase heat transfer devices\*, FT4 Powder Rheometer (measuring the flow properties and the behavior of porous media), mercury intrusion porosimetry, gas adsorption, G3 Morphologi. \*Including apparatus fabrication.

- *Numerical Modelling*: Capillary induced flow in porous media, modelling of two-phase flow, thermo-fluidic modelling of deformable microstructures, finite difference modelling of porous flow regimes, and pore and particle network modelling for permeability and effective thermal conductivity of porous media, respectively.
- *Analytical Techniques*: XRD, X-plane, XRM, AFM, IR thermography, SEM, G3 Morphologi.

#### **Computer Programmes Relevant to the Research and Data Analysis:**

- *Computational solvers*: CFD, ABAQUAS, SolidWorks, COMSOL Multiphysics.
- *Data processing and analysis*: ORS Dragonfly (XRM), Realtherm, ThermoCAM Researcher, Java, Python, MATLAB, AutoCAD, G3 Morphologi, ImageJ, Photoshop.

### **ADDITIONAL COURSES**

I received training in “*TUSLA Children First*” child protection and inclusion. I am fully vetted (2021-2026) to partake in mentoring and teaching activities for person(s) under the age of 18 in accordance with parental consent legislations.

#### **Other Activities and Leadership roles:**

##### *Student leadership position:*

- I was project supervisor to a second-level student who was awarded 1st place in the All-Island secondary school SFI Young Scientist festival, with over 430 applicants: SciFest Best Communicator and Presentation Award, and the SciFest Science Foundation Ireland Best Project Award. (October 2020).
- I supervised three second-level students for two-week internships, giving them an insight into research in mechanical engineering and the opportunity to work alongside a Ph.D. candidate studying two-phase heat and mass transfer.

### **EXTRACURRICULAR AND MEDIA EXPERIENCE**

- International surf lifesaver (5 European championships, 6 European Medals, 3 World Championships, 7 world finals,
- top rank 4th).
- Ex-International Swimmer (4 international medals, 32 national medals, European standard qualification, Four-year university sports scholarship recipient).
- Coached >400 people (all abilities) sea swimming, >100 people pool swimming (all abilities), >100 surf lifesaving.
- I have lifeguarded local beaches during the summer months for four years and volunteered to act as a lifeguard and water pollution officer for five globally recognised events in proximity to lakes/rivers/beaches.
- I have curated, been photographer for, and assisted in blogging of social media accounts for sports clubs (Facebook local surf lifesaving club, Audience: 1.9 k followers / @watersafetyireland Facebook and Instagram, Audience: ~2,700 followers), local start-ups (@Ispyteam, Audience: 14.5k followers / @NüdestFoods Instagram and twitter Audience: ~1,500 followers), and stakeholders (LinkedIn @CONNECTCentre Audience: ~3,000 followers and Twitter @connect\_ie Audience: 4,700 followers).
- I was involved in filming, editing, and participating in videos for the CONNECT Centre’s Summer school for machine learning (2019), I Spy Clothing (2018 – 2020), and Nüdest Foods (2020).
- I have participated in Instagram takeovers for social media accounts (@Watersafetyireland, @Ispyteam)
- I have written and been interviewed in numerous local and national level-newspapers.