

# RESEARCH @

University Research Council – University of Peradeniya



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URC e-Newsletter  
December 2021

# FUNDING OPPORTUNITIES

## HORIZON EUROPE

**Horizon Europe (2021-2027)** is the **9th European Union Framework Programme for Research and Innovation**. It is the biggest and most ambitious programme of its kind ever with a budget of over €95 billion. The 5 defined missions are related to cancer, carbon-neutral cities, climate change, oceans and waters, and soil health.

Our researchers can participate in Pillar-II consortiums and receive funding. However, we cannot lead Horizon Europe grants. Applications should be submitted by a Member State or an Associated Country.

The application form will have two parts: Part A contains administrative information about the applicant organisations, the summarised budget for the Proposal and call-specific questions and Part B contains the technical description of the project. The Proposal should be designed to stay as close as possible to the award criteria and highlight the technology readiness and social readiness levels.

The applications are evaluated based on **Excellence, Impact, and Quality and efficiency of the implementation**. The horizon Europe emphasises open science practices, including early and open sharing of research, research output management, reproducibility of research outputs, open access to research outputs, and involving all relevant knowledge actors. It is important to deposit research outputs in trusted repositories.

To apply please click the following link: [https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe\\_en](https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)

For further details please refer to the October edition – e-Newsletter

# FUNDING OPPORTUNITIES

## OTHER

### Research Grants

#### 1. Italian Fund for Science – fundamental research call

The Ministry of Universities and Research, under its Italian Fund for Science (FIS), invites applications for its fundamental research call. This supports fundamental research in the sciences in Italy. The following grants are available:

- starting grants, for applicants who are between two and 10 years from receiving their PhD – the total budget is €20 million to fund grants worth up to €1m each;

- advanced grants, for applicants who are more than 10 years from receiving their PhD – the total budget is €30m to fund grants worth up to €1.5m each.

Applicants may be of any nationality. They must demonstrate research expertise, with a minimum number of peer-reviewed publications and international recognition. The grant must be held at an Italian university or public research institution and applicants must enter into an employment agreement with the host institution at least for the duration of the grant. Applications must be submitted in English.

The maximum project period is five years. Projects in the life sciences, physical sciences or engineering may request up to an additional €500,000 for the purchase of equipment.

**Closing date** 27 December 2021

**Deadline Information** Applications are invited between 26 October and 12 noon Italian time, 27 December 2021.

**Date added** 19 October 2021

**Award type** Directed grants for individual investigators

**Award amount** max €2,000,000

**Country of applicant institution** Any

**Nationality of researcher** Any

## **2. Grants for international research visits**

The Lappeenranta University of Technology Research Foundation invites applications for its grants for international research visits. These support both researchers going abroad and those arriving at Lappeenranta University of Technology. The purpose of these grants is to encourage individual researchers and research groups to advance international research cooperation and to increase the number of articles published in internationally respected science publications. Researchers at any career stage may apply. Grants cover travel and accommodation expenses for visits lasting between three and 12 months.

**Closing date** 25 November 2021

**Deadline Information** Applications due by 4pm. This call is repeated once a year.

**Country of applicant institution** Any

**Indexed with these disciplines** Engineering; Business & Management Studies; Computer Science & Informatics

[Postgraduate students and post-doctoral researchers - Research Foundation of Lappeenranta University of Technology \(lut-tukisaatio.fi\)](#)

## **3. Wellcome Discovery Awards**

This scheme provides funding for established researchers and teams from any discipline who want to pursue bold and creative research ideas to deliver significant shifts in understanding that could improve human life, health and wellbeing.

**Where the host organisation of the lead applicant is based:**

UK, Republic of Ireland, [Low- or middle-income countries \(apart from India and mainland China\)](#)

**Level of funding:**

You should ask for the resources you need for your research programme – see the 'What we offer' section on this page. You will need to justify this in your application.

**Duration of funding:**

Usually 8 years, but may be less for some disciplines, and longer if held on a part-time basis.

**Deadline:** 24 March 2022, 17:00 GMT

[Wellcome Discovery Awards - Grant funding | Wellcome](#)

#### **4. JR Smallwood Foundation for Newfoundland and Labrador Studies, CA**

The JR Smallwood Foundation invites applications for its research grants. These support travel, subsistence, research assistance and material and supplies for approved research projects.

Applications are open to students, faculty members and non-affiliated scholars from any institution. Priority will be given to new applicants or former applicants with new projects.

Grants are worth up to CAD 5,000 each for one year.

**Closing date** 15 December 2021

**Deadline Information** This call is repeated once a year.

**Award type** Directed grants for individual investigators

**Award amount** max CAD 5,000

**Country of applicant institution** Any

[Research Grant | J R Smallwood Foundation | Memorial University of Newfoundland \(mun.ca\)](#)

#### **5. Development innovation ventures**

The Agency for International Development (USAID) invites applications for its development innovation ventures grants. These support development innovations that improve the lives of people living in poverty in the developing world. The scheme provides tiered funding to pilot, test and transition to scale innovations that demonstrate evidence of impact, cost-effectiveness and the potential to scale. DIV supports innovations across all countries and development sectors in which USAID operates, including health, education, water, energy and economic development. Funding is available in the following stages:

•**stage 1** – to support piloting of innovations in a developing country context, worth up to USD 200,000;

•**stage 2** – to support the further testing and expansion of innovations beyond the piloting stage, worth up to USD 1.5 million;

•**stage 3** – to transition proven approaches from piloting and testing to widespread scaling in new contexts or new geographies, worth up to USD 15 million;

•**evidence generation** – to generate evidence on the causal impact of widely implemented development approaches that still lack sufficient rigorous evidence of impact and cost-effectiveness, worth up to USD 1.5 million.

Anyone may apply, including businesses, non-profit organisations, researchers, faith-based entities and governments.

**Closing date** 31 October 2022

**Deadline Information** This call is repeated once a year.

**Date added** 04 November 2021

**Award type** Innovation grants; Directed grants to institutions, research groups etc; Prototypes and demonstrations; Technology innovation/development; Development (Africa/Caribbean)

**Award amount max** USD 15,000,000

**Country of applicant institution** Any

**Nationality of researcher** Any

[Development Innovation Ventures Annual Program Statement | Development Innovation Ventures | U.S. Agency for International Development \(usaid.gov\)](#)

## 6. Postdoctoral Research Visit

The Institute of Advanced Scientific Studies (IHES) invites applications for its postdoctoral research visits. These enable postdoctoral researchers to conduct research in mathematics, theoretical physics and theoretical biology at IHES.

Funding covers a visit of two years, with a possible extension of one year, starting from the following academic year.

**Closing date** 03 December 2021

**Deadline Information** This call is repeated once a year.

**Award type** Early-Career fellowships

**Country of applicant institution** Any

**Nationality of researcher** Any

[IHES – Applications](#)

## 7. Sustainability Journal travel awards

The Multidisciplinary Digital Publishing Institute, on behalf of the Sustainability Journal, invites abstracts its travel awards. These support junior scientists in attending an international conference in 2022 in the field of sustainability and sustainable development in order to give a presentation or present a poster.

Waste Recycling, Reduction & Recovery; Environmental Manufacturing; Sustainable Development & Resource Use; Renewable Energy Engineering  
Applicants must be PhD students or postdoctoral fellows.

Five awards, worth CHF 600 each, are available.

**Closing date** 31 January 2022

**Award type** Travel to conferences, meetings etc.

**Award amount max** CHF 600

**Country of applicant institution** Any

[Sustainability | Awards \(mdpi.com\)](https://www.mdpi.com/journal/sustainability)

### **8. Quantum-enabled bioimaging and sensing approaches for bioenergy**

The US Department of Energy, through its Office of Science, invites applications for its quantum-enabled bioimaging and sensing approaches for bioenergy funding call. This supports fundamental research or use-inspired technologies of new bioimaging or sensing approaches that exploit quantum phenomena. Projects that incorporate quantum science concepts to enhance spatial and temporal resolution, measurement speed, long-term sample stability, or sensitivity of bioimaging technologies are desirable. Foreign entities may apply in consortium with domestic entities. The total budget is USD 15 million. 14 awards are available worth up to USD 750,000 each.

**Closing date** 14 January 2022

**Date added** 17 November 2021

**Award amount max** USD 750,000

**Award amount min** USD 250,000

**Country of applicant institution** Any

<https://iee.psu.edu/funding/opportunities/quantum-enabled-bioimaging-and-sensing-approaches-bioenergy>

### **9. GKCCT Research Funding Round 2021**

The GKCCT is working to fund world-class research into rare aggressive childhood cancers including rhabdoid and other rare aggressive cancers. A project grant of up to £100,000 and up to three years is available for a clearly defined research project addressing a key question in rare, non-CNS (but including AT/RT) solid tumours of childhood, in particular rhabdoid tumours (all types), non-Wilms renal tumours and rare soft tissue sarcomas.

## 10 2021 UNESCO-TWAS Research Grant for Individual Scientists

Security models for two-party authenticated key exchange (AKE) protocols have been developed over the years to address various attack scenarios against AKE protocols. The extended Canetti–Krawczyk (eCK) security model is widely used to provide security arguments for AKE protocols because of its clear definitions of security as well as advanced adversarial capabilities. Most of the eCK-secure AKE protocols are proven to be secure in the random oracle model (ROM). The ROM is an ideal-world assumption, whereas the standard model captures the real-world assumptions. In this project, we investigate different security improvements on AKE protocols, such as leakage resiliency, secure pairing-based constructions, etc. Our aim is to come up with new provable-secure protocol constructions in the standard model.

**Award amount** : US\$ 11,800

**Closing date** : November 2023.

**Country of applicant institution** Any Individual

## For Early Career Researchers

### 1. Copenhagen bioscience PhD programme

The Novo Nordisk Foundation invites applications for its Copenhagen Bioscience PhD Programme. These support international students in obtaining a PhD in a bioscience related field in Copenhagen, Denmark. The four-year programme is divided into a pre-doctoral year followed by three years of PhD training at the University of Copenhagen or the Technical University of Denmark at one of the following centres in Copenhagen:

- Novo Nordisk Foundation (NFF) center for protein research;
- NFF center for biosustainability;
- NFF center for basic metabolic research.

Applicants of all nationalities may be awarded funding. Applicants



must hold, or anticipate receiving before enrolment, a university degree that formally qualifies the applicant to enter a PhD programme. The programme is also open for applicants with a Danish degree who can document at least 12 months of full-time research experience from outside Denmark, confirmed by at least one of their academic references. International applicants must also provide proof of English language skills.

Up to 16 positions are available. Full salary and tuition fee will be covered by the Novo Nordisk Foundation. Funding for the first year is awarded unconditionally to all successful applicants. Funding for the following three years is awarded conditionally, to be approved following a successful qualifying assessment at the end of the first pre-doctoral year.

**Closing date** 17 January 2022

**Deadline Information** Applications due by 2pm CET.

**Date added** 01 November 2021

**Award type** Predoctoral fellowships

**Award amount** max DKK 800,000

**Country of applicant institution** Any

[Copenhagen Bioscience PhD Programme - Novo Nordisk Fonden](#)

## 2. Godfrey Hewitt mobility award

Applicants must be ESEB members within six years of the start date of their PhD. Applicants who are more than six years from the start date of their PhD may apply, if they have had career breaks or for other reasons have not worked continuously. Applicants may be of any nationality.

**Award amount** €2,000.

**Closing date** 15 January 2022 (Forecast)

**Country of applicant institution** Any

<https://eseb.org/prizes-funding/godfrey-hewitt-mobility-award/>

### **3. Nagamori awards**

The Nagamori Foundation invites application for its awards. These recognise researchers or development engineers who have been working in technical fields relating to motors, actuators and power generators, and their control methods and application technologies. Applicants must be entry to mid-career researcher or engineers within 30 years of obtaining their bachelor's degree.

One award is worth JPY 5 million and five awards are worth JPY 2 million.

**Closing date** 31 January 2022

**Award amount max** JPY 5,000,000

**Award amount min** JPY 2,000,000

[Application Guidelines | Nagamori Foundation \(nidec.com\)](https://www.nidec.com)

### **4. Erasmus Mundus design measures**

The Education, Audiovisual and Culture Executive Agency's Erasmus+ programme invites applications for its Erasmus Mundus design measures call. This encourages the development of new, innovative, high-level integrated transnational study programmes at master's level. The master's programme should:

- offer a fully integrated curriculum delivered by a consortium of at least three HEIs from three different countries, of which at least two must be programme countries;
- aim to recruit students worldwide;
- include compulsory physical mobility for all recruited students;
- lead to either a joint degree or multiple degrees, or a combination.

**Closing date** 16 February 2022

**Deadline Information** Applications are invited between 15 December 2021 and 5pm Brussels time, 16 February 2022.

**Date added** 30 November 2021

**Award type** Directed grants to institutions, research groups etc;  
Institutional development

**Award amount max** €55,000

## 5. Mpala postdoctoral fellowship

The Smithsonian Institution invites applications for the Mpala postdoctoral fellowship. This promotes the study of biology, anthropology, geology, hydrology, material science, social science, soil science or related areas in an topic appropriate to Mpala. Proposed projects must be tenable in residence at the Mpala research centre. Candidates are expected to conduct research in association with members of the Smithsonian professional research staff and to make use of the resources of the institution. The fellow must also collaborate with an appropriate Kenyan or international organisation in Kenya. There are two streams:

- postdoctoral fellowships – applicants must have completed or be near completion of their PhD at the time of application;
- senior fellowships – applicants must have had a PhD or equivalent for a minimum of seven years. The fellowship provides a stipend of USD 55,000 per year for a period of one or two years and a research allowance of up to USD 4,000 for research-related expenses. The majority of the fellowship period should be spent in residence at Mpala.

**Closing date** 15 January 2022

**Award type** Early-Career fellowships; Senior fellowships; Mid-Career fellowships

**Award amount max** USD 114,000

**Award amount min** USD 55,000

[Smithsonian Mpala Postdoctoral Fellowship | Office of Fellowships \(si.edu\)](#)

## 6. Wellcome Early-Career Awards

This scheme provides funding for early-career researchers from any discipline who are ready to develop their research identity. Through innovative projects, they will deliver shifts in understanding that could improve human life, health and wellbeing. By the end of the award, they will be ready to lead their own independent research programme.

**Where your host organisation is based:** UK, Republic of Ireland, [Low- or middle-income countries \(apart from India and mainland China\)](#)

**Level of funding:** Salary and up to £400,000 for research expenses

**Duration of funding:** Usually 5 years, but may be less for some disciplines, and longer if held on a part-time basis

**Host organization:** You must have sponsorship from an [eligible host organisation](#) in one of the following: UK Republic of Ireland a [low- or middle-income country](#) (apart from India and mainland China).

**Application Deadline:** 15 February 2022, 17:00 GMT

[Early-Career Awards - Grant funding | Wellcome](#)

## **7. Obama Foundation Scholars Program 2022- 2023**

The Obama Foundation Scholars Program at Columbia University seeks rising leaders from the United States and around the world who meet the following criteria:

Are emerging leaders who have made meaningful contributions to their field and are now at a “breakthrough moment” in their careers

Have a proven commitment to service and leadership within a community, region or country, coupled with a demonstrated commitment to return to these communities following their completion of the program and apply their enhanced training, skills, and connections on a long-term basis for the benefit of these communities

Are fluent in English (verbal, written and spoken)

- Have the ability and inclination to positively shape the future of their community
- Have a demonstrated commitment to inclusivity, community-orientation, hope, courage, imagination, strategy, accountability, integrity and resilience

**Deadline: December 22 at 5PM ET**

<https://worldprojects.columbia.edu/application-information>

# Research Awards

## 1. Michael Faraday prize and lecture

The Royal Society invites nominations for the Michael Faraday prize and lecture. This recognises a scientist or engineer whose expertise in communicating scientific ideas in lay terms is exemplary. Self-nominations are not accepted.

The prize includes a medal and a gift of £2,500.

**Closing date** 25 February 2022

**Award type** Prizes

**Award amount max** £2,500

**Award amount min** £2,500

**Country of applicant institution** Ireland; Commonwealth member states

[Michael Faraday Prize and Lecture | Royal Society](#)

## 2. Mullard award

The Royal Society invites nominations for the Mullard award. This recognises those with an academic record in any area of natural science, engineering or technology and whose work is currently making or has the prospect to make a contribution to national prosperity in the UK. The award includes a prize of £2,000 and a travel grant of £1,500.

**Closing date** 25 February 2022

**Date added** 01 December 2021

**Award type** Prizes

**Award amount max** £3,500

**Country of applicant institution** Ireland; Commonwealth member states

[Royal Society Mullard Award | Royal Society](#)

# RESEARCH RESOURCES

## Research Publication Facilitation Fund

This is a scheme initiated by URC to provide financial assistance up to a maximum of USD 1000.00 per year for the researchers of the University of Peradeniya to facilitate publishing their research findings in high-ranking peer reviewed journals. We invite you to utilize this facility by downloading an application form from:

[https://www.pdn.ac.lk/centers/urc/doc/Application%20For%20RPFF\\_URC\\_2021](https://www.pdn.ac.lk/centers/urc/doc/Application%20For%20RPFF_URC_2021)

**Financial assistance:** USD 500 per author up to a maximum of USD 1000 per paper per year.

### **Eligibility:**

- The applicant should be a permanent staff member of the University of Peradeniya and one of the authors of the journal article.
- Research work carried out by a permanent staff member of the University of Peradeniya completely outside the University of Peradeniya may also be eligible.
- The journal should be indexed in SCI/SSCI or SCI-expanded/SSCI-expanded journal with a journal impact of 2 or higher.
- Should use the official e-mail address with pdn domain name provided by the University of Peradeniya

**Frequency:** Once a calendar year.

**Procedure:** The applicant should fill in an application form and submit the same to the Director, URC through the Head of the Department and the Dean of the Faculty along with the original copy of the receipt for the payment of page charges and a copy of the journal article.

**Others:** The URC reserves the right to amend the selection criteria. The article processing charge will be reimbursed subject to the availability of funds.

**Mailing Address:** The Director, University Research Council, A6 Building, Udaperadeniya Road, University of Peradeniya.

**E-mail Address:** [secretaryurc@gs.pdn.ac.lk](mailto:secretaryurc@gs.pdn.ac.lk)

# UPCOMING EVENTS

## 10th International Conference on Fermented Foods, Health Status and Social Well-being

The University Research Council of the University of Peradeniya is pleased to inform you that the 10th International Conference on Fermented Foods, Health Status and Social Well-being is scheduled to be held on the **17th & 18th of December 2021 as a hybrid event at the University of Peradeniya, Sri Lanka.**

During the past twenty years, the conference has been organized mainly in India as a biennial event by the Swedish South Asian Network on Fermented Foods (SASNET-FF). This year it will be organized jointly by The University Research Council of the University of Peradeniya, Sri Lanka and SASNET-FF in association with SASNET-Lund University, Sweden; Dr Varghese Kurien Centre of Excellence, Institute of Rural Management, Anand, India; Copenhagen University, Denmark; Kamdhenu University, India; Anand Agricultural University, India; Indian Dairy Association (Gujarat State), Gut Microbiota and Probiotic Science Foundation India, Probiotic Association of India and the University of Sri Jayewardenepura, Sri Lanka.



# CALL FOR ABSTRACTS

## 10<sup>th</sup> International Conference on Fermented Foods, Health Status and Social Well being

'Nutritional, Functional and Immunological  
Aspects of Fermented Foods'



### REGISTER NOW!

<https://www.pdn.ac.lk/ic/sasnet/>

17<sup>th</sup> & 18<sup>th</sup>  
December  
2021

Submit the abstracts to  
[fermentedfoodslk@gmail.com](mailto:fermentedfoodslk@gmail.com)  
On or before  
**November 25, 2021**

Faculty of Agriculture,  
University of Peradeniya,  
Sri Lanka

**Contact us**

[fermentedfoodslk@gmail.com](mailto:fermentedfoodslk@gmail.com)  
<http://fermented-foods.net.in/>

**Organized by**

The University Research Council, University of Peradeniya

**In collaboration with**

Swedish South Asian Network on Fermented Foods(SASNET-FF)

**In Association with**



For registration, please click the following  
link. <https://www.pdn.ac.lk/ic/sasnet/>

For further details, please check our webpage by clicking the  
following link. <https://www.pdn.ac.lk/ic/sasnet-ff/>

**Kindly note that the registration is free for Sri Lankan  
students who join virtually.**



# RESEARCH RECOGNITIONS

## **Award of Excellence in Research, Faculty of Engineering - Year 2020**

### **Awardees**

Dr. H.M.V.R. Herath

Dr. K.K. Wijesundara

Dr. M.C.M. Nasvi

Dr. G.M.R.I. Godaliyadda

### **Certificate of Commendation**

Dr. M.P.B. Ekanayake

Dr. K.G.N. Nanayakkara

Dr. J.A.B. Alawathugoda

Dr. S.K. Navarathnarajah

## **Award of Excellence in Research, Faculty of Science - Year 2020**

### **Department of Botany Awardees**

Prof. DMD Yakandawala

Prof. KMGG Jayasuriya

Prof. SCK Rubasinghe

Dr. AMTA Gunaratne

### **Department of Chemistry Awardees**

Prof. RMG Rajapakse

Dr. ACA Jayasundara

Dr. JMSJ Menike

Dr. WSS Gunatilake

### **Department of Geology Awardees**

Prof. MASPK Malaviarachchi

Prof. LRK Perera

Dr. PL Dharmapriya

### **Department of Molecular Biology & Biotechnology Awardees**

Prof. RGSC Rajapakse

Prof. SDSS Sooriyapathirana

**Department of Physics**

Dr. TMWJ Bandara

**Department of Statistics and Computer Science Awardees**

Prof. P Wijekoon

Dr. LS Nawaratne

**Department of Zoology Awardees**

Prof. SHPP Karunaratne

Prof. RS Rajakaruna

Prof. WAPP De Silva

**Faculty of Allied Health Sciences**

**List of Faculty Research Awardees 2020**

Dr. Bimali Sanjeevani Weerakoon

Dr. W.M.G.M.B Bowatte

DR. R.P Illeperuma

Dr. Ishanka WEerasekara

Dr. Nilupa r. Amarasinghe

Ms. .M.R.K.G. nandasena

Ms. V.M.B.K.T.Malwanage

Dr. Malshani L Pathirathna

Dr. Sarath rathnayake

Mr. B.M.C. rathnayake

Dr. A.C.M. Fahim

Dr. M.H.F. Sakeena

**Scientific Publication Awards – Faculty of Medicine, University of Peradeniya 2019**

Prof. Asiri Abeyagunawardena

Prof. VS Weerasinghe

Prof. F Noordeen

Prof. DM Dissanayake

Prof. DMG Fernando

Prof. NS Kalupahana

Prof. SD Dharmaratne

Prof. Susiji Wickramasinghe

Prof. Tharaka Dassanayke

Prof. Udaya Ralapanawa  
Prof. Roshitha Waduge  
Prof. Kalana Maduwage  
Prof. Devika Iddawela  
Dr. Shanthini Rosairo  
Dr. Manoji Pathirage  
Dr. Saman Nanayakkara  
Dr. Indu Nanayakkara  
Dr. AN Vadysinghe  
Dr. Veranja Liyanapathirana  
Prof. HKI Perara  
Dr. S Thalgahagoda  
Dr. WT Fernando

**Commendable researchers of the Faculty of Veterinary Medicine and Animal Science based on the stated criteria (publications in peer reviewed journals) 2020**

At least one full paper in an international peer reviewed journal (Impact Factor 1 or above)

D.R.A. Dissanayake  
H.M.H.S. Ariyaratna

Two or more papers in peer reviewed local journals or in journals with impact factor <1)

H.M.S. Wijekoon

**Annual Research Excellence Award - Faculty of Agriculture- 2019**

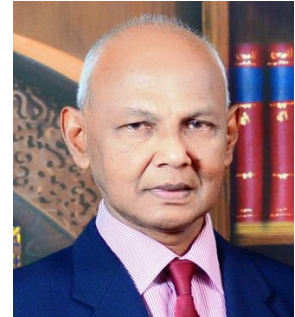
**Awardees**

Dr. Geeshani Somaratne  
Dr. Lalith Rankoth  
Dr. Lasantha Weerasinghe  
Dr. Rohitha Prasantha  
Prof. Gamini Pushpakumara  
Prof. Terrence Madhujith  
Prof. Pradeepa Bandaranayake  
Prof. Swarna Wimalasiri

# ANALYSIS

## 'Disciplinarity' and Analogy

by  
**Priyan Dias**  
Emeritus Professor in Civil Engineering  
University of Moratuwa,  
Sri Lanka



**Priyan Dias**, PhD(Lond), DIC, CEng, MIStructE, FIE(SL), NASSL, is an emeritus professor in civil engineering at the University of Moratuwa and consultant/professor at the Sri Lanka Institute of Information Technology. He was the founder Director of Research at the University of Moratuwa (2014-2017), a member of the National Research Council (2005-2019), and an associate editor of *Civil Engineering & Environmental Systems* (2007 to date). He is currently President of the National Academy of Sciences of Sri Lanka. Apart from his many technical publications, he has authored a book with Springer Nature in 2019 titled *Philosophy for Engineering: Practice, Context, Ethics, Models, Failure*.

### 'Disciplinarity' and Analogy

Human knowledge has got to where it is today because of specialization. No single individual is now able to grasp the entirety of human knowledge, so the result is ever increasing specialization. While this has resulted in a proliferation of scholarship, the application of that expertise has been curtailed, because such applications often involve a multitude of disciplines. Furthermore, even the very growth of specialist knowledge has sometimes been hindered because of the so called 'silo effect', and breakthroughs in learning often come from 'outsiders' belonging to other disciplines. John Dalton is an example that comes to mind; while known as a chemist because he proposed the law of multiple proportions in which atoms combine to form molecules, he had previously published books on meteorology and English

grammar! For some of the above reasons, there is a greater call now for a spectrum of interaction among disciplines. At one end of this spectrum could be multidisciplinary work, where individuals from different disciplines work together, especially in solving practical problems, each drawing on their separate disciplinary knowledge. At the other end of the spectrum, interdisciplinary approaches are ones where new disciplines can emerge through the combination of others – for example statistical mechanics, referred to later. Transdisciplinary approaches seek to generalize across diverse knowledge systems – general systems theory was an attempt to do so. Cross-disciplinarity is around the middle of the above spectrum, where disciplines do not necessarily merge, but insights from one discipline inform another.

Analogical transposition is one example of cross-disciplinarity. In some ways it presupposes the concept of an essential unity in human knowledge. Analogy is not foreign to disciplines such as physics and engineering. For example, we use a ‘membrane analogy’ to derive the equations for torsional stress in beam cross sections; or a ‘truss analogy’ to understand the role of shear reinforcement in reinforced concrete beams. These examples, however, only constitute a rather narrow, , albeit extremely useful, manifestation of analogy.

The correspondence between the two domains linked by the analogies is very tight and completely defined by common mathematical expressions, leaving little room for creative interpretation. Snodgrass and Coyne (1992) on the other hand argue that metaphors should be open ended so that multiple interpretations are possible. It is this type of metaphor or analogy that we explore.

### **Example 1 - Statistics and Mechanics**

Consider the relationship between statistics and mechanics. An example of a *multi-disciplinary* approach is the Monte Carlo simulation of probabilistic processes. For example, if we want to find the fragility curves for a family of similar structures impacted by tsunamis, the probabilistic distributions of the structural parameters (e.g. wall height, density, thickness and strength) and

that of the tsunami waves (e.g. height, velocity) are sampled for many sets of combinations, and the mechanics simulations of load versus resistance performed many thousands of times. This will generate the percentage of such structures that are likely to enter a given damage state (e.g. collapse) – which is what is required to construct fragility curves (Nanayakkara and Dias, 2016). The statistics and mechanics domains are combined to yield a practically useful result.

*Cross disciplinarity* through analogy goes a little further. For example, moments of area are parameters that appear in both statistics and mechanics. The first order raw moment, second order central moment, third order standardized moment and fourth order standardized moment of a probability distribution function are called the mean, variance, skewness and kurtosis of the probability distribution, respectively. In mechanics, the zeroth raw moment of area of a cross section gives the area of the section; the first raw moment of area of a cross section as a fraction of the area of section gives the distance to the centroid of the section; and the second raw moment of area of a section as a fraction of the area of the section yields the well-known definition of radius of gyration. Mechanics correlates for skewness and kurtosis are not generally known. However, work done by Nanayakkara et al. (2019) demonstrated that there is a linear relationship between standardized third moment of area of an I-section and its rotation capacity. Furthermore, pursuing an analogy with kurtosis, Nanayakkara and Dias (2021) developed the concept of “normalized excess kurtosis” as an index for the rotation capacity of hollow steel sections; it was found to have much better correlation with rotation capacity than the commonly employed slenderness ratio, based on both experimental results and numerical simulations. So here statistics serves as a source domain to generate new theoretical insights, practically useful too, in the target domain of mechanics. Even deeper (i.e. *interdisciplinary*) interactions between statistics and mechanics can give rise to new fields such as statistical mechanics, which is employed in mechanics at the molecular level through methods such as molecular dynamics simulation – e.g. to study the influence of defects on the mechanical behaviour of graphene sheets (Dewapriya et al. 2020).

## Example 2 - Ductility

Ductility is a very important concept in structural materials. The stress-strain curve of a ductile material is generally linear; however at the 'yield point' the material will undergo large strains for virtually constant stress, but without fracturing. This means that structural members made of ductile materials, even if accidentally overloaded, will not fail suddenly, but rather maintain loads at their yield capacities. This concept can be analogically transposed from the material level to the structural system level by designing such systems in a way that smaller elements in the load carrying chain fail before larger ones, thus preventing catastrophic collapses - we can say then say (metaphorically) that the 'system' is ductile (Dias, 1994). Transposing again the concept of ductility to infrastructure provision, we can reduce the amount of infrastructure constructed (and thereby the environmental stress on the planet) if they can be designed to function differently at 'high stress'. For example, Kuala Lumpur's Stormwater Management and Road Tunnel (SMART tunnel) carries both traffic and stormwater (below the road surface); but during occasional, once in several year heavy flooding (analogous to a 'yield point'), the tunnel is closed to traffic and the entire cross section used to discharge the floodwater (Navaratnarajah, 2016). Thus separate tunnels for traffic and stormwater are avoided.

## Closure

Despite Aristotle's general skepticism of metaphor (something very close to analogy), Lloyd (2015) says that "Aristotle, in one of his rare moments of appreciation of metaphor.... wrote in the Poetics (1459a5-8) that skill in its use was a mark of genius and cannot be taught" (p. 106). It involves 'plausible' as distinct from 'demonstrative' reasoning (Polya, 1954), and can be of great value in generating both new theoretical insights and neat practical solutions, while building bridges across disciplines.

The above are authors views and URC invites critiques for ideas expressed by author.

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