STUDENT CHAPTER CONFERENCE

SIAM®

1st December 2017,

National University of Ireland, Galway

maths.nuigalway.ie/SIAM-Galway

Welcome

Welcome to NUI Galway and to the fourth Annual Irish SIAM Student Chapter Conference.

The NUI Galway SIAM Student Chapter was founded in September 2014. Echoing SIAM's mission, our goal has been to facilitate interdisciplinary collaboration between students from different disciplines, including mathematics, applied mathematics, statistics, computer science, engineering, economics, physics and other sciences. To work towards that goal, we held our first student conference in December 2014. That meeting was a great success and became an annual event, most recently hosted by our good friends at the University of Limerick in December 2016. We are delighted to continue this annual tradition by welcoming over forty participants from seven institutions to the 2017 Irish SIAM Student Chapter Conference today. Just six short months after our chapter hosted the sixth Annual UKIE SIAM Student Chapter Conference we are once again looking forward to a day packed with interesting presentations, and great opportunities to share our research, ideas and discoveries.

We would like to thank our invited guests, Nicole Beisiegel of University College Dublin and Catherine Enright of Valeo Vision Systems for so readily agreeing to participate. We are also very grateful to the support staff of the School of Mathematics, Statistics and Applied Mathematics for their assistance. In particular we would like to acknowledge the huge amount of work done to make this chapter a success by our faculty advisor Niall Madden.

We also acknowledge the financial support we have received from SIAM, NUI Galway's MathSoc, the Stokes Cluster and CORE.

We hope you enjoy your time in Galway, and we look forward to seeing you again soon at another SIAM event.

Organising Committee
Eoghan Staunton (Chapter President)
Roberto Galizia (Chapter Vice-President)
Cian O'Brien (Chapter Secretary)
Hannah Conroy Broderick (Chapter Treasurer)
Niall Madden (Faculty Advisor)
Nisreen Alkobi
Faiza Alssaedi
Richard Burke
Paul Greaney
Aoife Hill
Róisín Hill
Vinh Mai
Robert Mangan
Christine Marshall
Qays Shakir
Michael Welby

Schedule

9:15-9:45	**Registration & Poster Setup (THB-G011)**	
9:45-10:00	Adrienne Gorman (AC201) Vice-Dean for Research, CoS	*Introduction & Welcome*
	Morning Session (AC201)	**Chair: Roberto Galizia**
10:00-10:40	**Plenary Lecture 1** Nicole Beisiegel	*Computational Methods for Water Waves*
10:40-11:00	Christopher O Connor	*Modern Theory of Coupled Lasers and Exceptional Points*
11:00-11:30	Coffee Break (THB-G011)	
	Afternoon Session 1 (AC201)	**Chair: Hannah Conroy Broderick**
11:30-11:50	Joey O Brien	*Feedback-based Stock Trading*
11:50-12:10	Shane Walsh	*Resonant collision of deep water waves in one-dimensional propagation*
12:10-12:30	Paul O'Keeffe	*Tipping in Ecosystems: Points of No Return*
12:30-13:50	**Luncheon and Poster Session (THB-G011)**	
	Afternoon Session 2 (AC201)	**Chair: Róisín Hill**
13:50-14:30	**Plenary Lecture 2** Catherine Enright	*The Vision For Driver Assistance*
14:30-14:50	Gary O'Keeffe	*Modelling the Efficiency of Nanofluid-based Solar Collectors*
14:50-15:20	Coffee Break (THB-G011)	
	Evening Session (AC201)	**Chair: Qays Shakir**
15:20-15:40	Miaad Alqurashi	*Application of State Space Models in Financial and Economic Data*
15:40-16:00	Kevin Devine	*Modelling of fold-type oscillation mark formation in continuous steel casting*
16:00-16:15	**Closing Remarks and Prizegiving**	

Plenary Talks

Computational Methods for Water Waves

Nicole Beisiegel[†], **Frédéric Dias**[‡]

[†]School of Mathematics and Statistics
University College Dublin, Dublin, Ireland
nicole.beisiegel@ucd.ie

[‡]School of Mathematics and Statistics
University College Dublin, Dublin, Ireland
frederic.dias@ucd.ie

ABSTRACT

Many aspects of our every day life are influenced by water: its presence or the lack thereof. The questions asked in this respect are about wave climate (marine renewable energy), hazard assessment and mitigation (storm surges and floods), simulations and early warning (tsunamis) or the prediction of rogue events (cargo transport).

Because of its many applications, the mathematical study of water waves is still a vast field of ongoing research. Due to the complexity of the underlying mathematical problem, two aspects are of crucial importance

- The simplification of the mathematical equations such that they accurately model the dominant physical processes, and allow for an accurate solution
- The development of robust and efficient numerical methods for their solution that allow for geometric flexibility and computational efficiency

In this talk, I am going to discuss two simplified equations: The 2D shallow water equations and the 3D Euler equations, both, which are valid in different flow regimes.

I am going to address the importance of slope limiting techniques using the example of tsunami simulations [4], and show how different types of polynomials in an adaptive Discontinuous Galerkin framework result in different properties of inundation simulations [1].

Using the 3D Euler equations, I will study wave amplification of storm waves using a high-order spectral model (see [3], [5]). Since these methods are computationally complex, they heavily rely on the efficiency of Fast Fourier transforms while parallel scalability is also of particular importance (see [2]).

Acknowledgement. We gratefully acknowledge our partnership with the Irish Centre for High-End Computing (ICHEC), and the support of the Science Foundation Ireland (SFI) under the research project 'Understanding Extreme Nearshore Wave Events through Studies of Coastal Boulder Transport' (14/US/E3111).

References

[1] Beisiegel, N., and Behrens, J., Quasi-Nodal Third-Order Bernstein Polynomials in a Discontinuous Galerkin Model for Flooding and Drying. *Environmental Earth Sciences* **74** (11), 7275–7284 (2015), DOI: 10.1007/s12665-015-4745-4.

[2] Beisiegel, N. and Dias, F. A Pseudo-Spectral Method for Extreme Storm Waves. *Proceedings of the Twenty-seventh International Offshore and Polar Engineering Conference*, accepted for publication (2017).

[3] Dommermuth, D. G. and Yue, D. K. P., A high-order spectral method for the study of nonlinear gravity waves. *Journal of Fluid Mechanics* **92** (184), 267–288 (1987).

[4] Vater, S., Beisiegel, N., and Behrens, J. A limiter-based well-balanced discontinuous Galerkin method for shallow-water flows with wetting and drying: Triangular grids. Under revision for publication in *Advances in Water Resources.*

[5] West, B. J. and Brueckner, K. A. and Janda, R. S. and Milder, D. M. and Milton, R. L., A New Numerical Method for Surface Hydrodynamics. *Journal of Geophysical Research* **92** (C11), 11,803-11,824 (1987).

The Vision For Driver Assistance

Catherine Enright

Detection Vision Systems, Valeo, Tuam, Ireland
catherine.enright@valeo.com

ABSTRACT

There are varying predictions on when fully autonomous vehicles will become a reality for all, estimates range from 2019 to 2040. However on the path to full automony a wide range of driver assistance features are making their way to market. These features are making driving safer, easier and more comfortable. A key enabler for these features is computer vision.

In this talk I will discuss the some of the driver assistance features that are making their way to market now and the roadmap to full autonomy. I will discuss the building blocks for autonomous driving with a focus on what computer vision brings to the field. Taking as an example the Home Parking Function we will look at the computer vision algorithms and underlying mathematical techniques under pinning the function.

Student Talks

Modern Theory of Coupled Lasers and Exceptional Points

Christopher O Connor, Sebastian Wieczorek, Andreas Amann

Department of Applied Mathematics,
School of Mathematical Sciences,
University College Cork.
*christopherconnor@umail.ucc.ie

ABSTRACT

Coupled lasers have become increasingly important given the development of many devices with applications in medicine, engineering and even modern household appliances. Single lasers have been well developed and understood. When two or more lasers are in close proximity, problems such as competition can occur between them. Physically, coupled lasers can be thought of as complicated non-linear oscillators. Given the arduous nature they present, standard classical laser theory cannot effectively describe such a system. Moreover, when the laser system is open, more complexities arise and as a result, there is no agreed theory at present. Modern developments in Photonic Integrated Circuits (PIC) [1] have led to designs with several coupled lasers integrated on sub-millimetre microchips but the stability of the output from such devices is still relatively unknown. Thus the main question is how can one describe the dynamics of such systems in a mathematical way?

Modern approaches describing the problem are currently being developed such as Steady-state ab initio Laser Theory (SALT) [2]. This takes on self-consistent laser equations and uses approximations to come up with a steady state formulation assuming both polarisation and population inversion are stationary. Some remarkable occurrences have been observed such as exceptional points (EPs) [3] which have been shown to cause suppression in the lasing output [4]. Our aim is to investigate the dynamics of the coupled laser system, thus we can determine the stability of the EPs. From here, experiments can be verified on PICs to confirm our mathematical model.

References

[1] Nagarajan, Radhakrishnan, Charles H. Joyner, Richard P. Schneider, Jeffrey S. Bostak, Timothy Butrie, Andrew G. Dentai, Vincent G. Dominic et al. "Large-scale photonic integrated circuits." *IEEE Journal of Selected Topics in Quantum Electronics 11,* no. 1 (2005): 50-65.

[2] Ge, Li, Yi D. Chong, and A. Douglas Stone. "Steady-state ab initio laser theory: generalizations and analytic results." *Physical Review A* 82 no. 6 (2010): 063824.

[3] Heiss, W. D. "The physics of exceptional points." *Journal of Physics A: Mathematical and Theoretical* 45, no. 44 (2012): 444016.

[4] Liertzer, Matthias, Li Ge, A. Cerjan, A. D. Stone, H. E. Treci, and S. Rotter. "Pump-induced exceptional points in lasers." *Physical Review Letters* 108, no. 17 (2012): 173901.

On The Theory of Feedback Based Stock Trading

Joseph O Brien†, **Dr. Kevin Burke**†, **Dr. Mark Burke**†

†MACSI, Department of Mathematics & Statistics
University of Limerick, Ireland
joseph.obrien@ul.ie

ABSTRACT

The use of control theory, specifically feedback systems, in a number of fields including economics and engineering is well studied, in recent years this has been extended to its use in stock trading. This talk will give an insight in to the Simultaneous Long-Short feedback control strategy introduced by Barmish and Primbs [1], and discuss how the design of the controller affects the resulting gains that may be made using the strategy.

The theory is based around initially investing an amount I_0 both long and short, then modulating the investment at time t based upon the cumulative gain made by this time, $g(t)$, and also a feedback parameter K which determines how much this change in investment depends on the gain. Which results in a gain given by:

$$g(t) = \frac{I_0}{K}\left[\Big(q(t)\Big)^{K} + \Big(q(t)\Big)^{-K} - 2\right] \tag{1}$$

Where $q(t)$ is the ratio between the equity price at time t and its initial price. Interestingly this is a strictly positive quantity, which suggests theoretically, the strategy should always result in positive gain. This result will be tested and the theory's limitations will then be discussed.

Further developments to the theory including incorporating alternative parameters on each side of the controller and also investing alternative amounts long and short will also be discussed and from this new robustness properties will also be shown. The theoretical final gain made by our model is given by:

$$g(t) = \frac{I_0}{K_L}\left[q(t)^{K_L} + \frac{\alpha q(t)^{-\beta K_L}}{\beta} - \frac{\alpha}{\beta} - 1\right] \tag{2}$$

Where $\alpha = \frac{-I_{S,0}}{I_{L,0}}$, is the ratio between the negative of the initial short investment and the initial long investment and $\beta = \frac{-K_S}{K_L}$, is the ratio between the negative of the short feedback parameter and the long feedback parameter.

The performance of this strategy when the price evolution is determined by Geometric Brownian Motion such that the price at time t is given by the stochastic differential equation:

$$dp = p\mu \; dt + p\sigma \; dW \tag{3}$$

where W represents a Weiner process, μ is the drift term and σ is the volatility term [2], will also be commented on and a quantitative result for the expected gain will be given.

References

[1] Barmish, B Ross and Primbs, James A, On a new paradigm for stock trading via a model-free feedback controller, *IEEE Transactions on Automatic Control*, 3:552-676, 2016.

[2] Hull, John C., and Sankarshan Basu. Options, futures, and other derivatives. Pearson Education India, 2016.

Resonant Collision of Deep Water Waves in One-Dimensional Propagation

Shane Walsh[†], **Miguel D. Bustamante**[‡]

[†]UCD School of Mathematics and Statistics,
University College Dublin, Belfield, Dublin 4, Ireland
shane.walsh.3@ucdconnect.ie

[‡]UCD School of Mathematics and Statistics,
University College Dublin, Belfield, Dublin 4, Ireland
miguel.bustamante@ucd.ie

ABSTRACT

We wish to study resonant interactions in deep water gravity waves by considering a minimal example of resonance involving the lowest possible number of modes interacting. The kind of nonlinear resonance we are looking for, named precession resonance, is triggered when the frequency of the precession of the triad phase matches the nonlinear frequency of the system.[1] We wish to analyse this by taking a truncated system of N modes, where N is the number of modes required to evoke resonant behaviour, and then taking a weakly-nonlinear approach by transforming the equations to their normal form, leaving the resonant quartets and quintets. We then wish to discuss the integrability of the transformed system with Kovalevskaya exponents using the method of Yoshida.[2] We also study numerical simulations of the system and compare them to related experimental data.

References

[1] D. Lucas, M. D. Bustamante and M. Perlin, *Precession resonance in water waves* arXiv:1608.04241 2016.

[2] H. Yoshida, *Necessary Condition for the Existence of Algebraic First Integrals* Celestial Mechanics (1983) 31: 363. https://doi.org/10.1007/BF01230292

Tipping in Ecosystems: Points of No Return

Paul E. O'Keeffe, **Sebastian Wieczorek**

School of Mathematical Sciences
University College Cork, Western Gateway Building, Cork, Ireland
paulokeeffe@umail.ucc.ie
sebastian.wieczorek@ucc.ie

ABSTRACT

We investigate tipping phenomena using an example of a low-dimensional but non-autonomous ecosystem model [1], where parameter shifts describe slow and transient changes in plant growth or herbivore mortality over time. We define tipping as a critical transition from a herbivore-dominating stable state to a plant-only stable state, and study this transition in a tipping diagram of the magnitude vs. the rate of the parameter shift. The main focus is on the interaction between bifurcation-induced tipping (B-tipping) due to critical magnitudes of the parameter shift, and rate-induced tipping (R-tipping) due to critical rates of change of the parameter.

Firstly, we analyse monotone parameter shifts and obtain a tipping diagram that can be explained in terms of (i) the bifurcation diagram of the corresponding autonomous system where all parameters are fixed in time, and (ii) forward basin instability of the moving herbivore-dominating stable state. Next, we ask: Given a monotone parameter shift that exceeds a critical magnitude or rate of change, can tipping be avoided by reversing the trend in the parameter change? Specifically, we introduce the notion of a point of no return past which tipping can no longer be avoided upon the reversal in the trend of the time-varying parameter. The analysis of non-monotone parameter shifts uncovers an intriguing tipping diagram with multiple critical rates and non-trivial dependence of points of no return on the amplitude and rate of the parameter shift. We demonstrate that such a tipping diagram is model-independent in the sense that it is characteristic of non-monotone parameter shifts across a generic steady bifurcation in the corresponding autonomous system.

References

[1] Scheffer, Marten and Van Nes, Egbert H and Holmgren, Milena and Hughes, Terry, Pulse-driven loss of top-down control: the critical-rate hypothesis. *J. Ecosystems.* Volume 11, Springer, 2008.

Modelling nanofluid-based direct absorption solar collectors

Gary J. O'Keeffe[†], **Sarah L. Mitchell,**[†] **Tim G. Myers,**[‡] **Vincent Cregan**[†]

[†] Department of Mathematics and Statistics
University of Limerick, Castletroy, Co. Limerick, Ireland
gary.okeeffe@ul.ie

[‡] Centre de Recerca Matemàtica
Campus UAB Edifici C, 08193 Bellaterra, Barcelona, Spain

ABSTRACT

In this presentation, I discuss models for predicting the efficiency of different types of nanofluid-based solar collectors. The models generally consist of a system of equations: partial differential equations describing the conservation of energy and momentum, and a radiative transport equation describing the propagation of radiation through a nanofluid. I will also talk about how we use asymptotic analysis, in conjunction with analytic, and numerical methods, to solve partial differential equations. Please see [1] for further reading.

Acknowledgement. G. J. O'Keeffe acknowledges the support of the Irish Research Council (GOIPG/2014/887).

References

[1] G.J. O'Keeffe, S.L. Mitchell, T.G. Myers, and V. Cregan, Modelling the efficiency of a nanofluid-based direct absorption parabolic trough solar collector. *Solar Energy* 159:44-54, 2018.

Application of State Space Models in Financial and Economic Data

Miaad Alqurashi

School of Mathematics Sciences,Financial Mathematics and Actuarial Science
University College Cork, Western Rd, Mardyke, Cork, Ireland
miaadalqurashi@ucc.ie

ABSTRACT

In dynamic modelling of financial and economic data the concept of cointegration plays an important role. It refers to the existence of long-term equilibrium relations between financial/economic variables in a dynamic environment. In the literature so-called VAR models with cointegration are popular. In its Edgeworth Centre, University College Cork are developing parameterization/estimation methods for alternative models, namely State Space models with cointegration. The research topic in this project is to study cointegration of financial data and how a state space representation of these processes exists. We will first start off by giving a brief introduction on cointegrated I(1) processes before explain further the variance model. After laying out the groundwork of the Engle and Granger approach and of Johanson's work using the VAR model;see[1][3], we will consider how a state space representation of the cointegration model using a maximum likelihood criterion can be beneficial as opposed to Johanson's VAR model. We introduce the state-space error correction model (SSECM) and discuss in detail how to estimate SSECMs by maximum likelihood methods, including reduced rank regression techniques which allow for a successive reduction of the number of parameters in the original constrained likelihood optimization problem;see(Thomas Ribarits and Bernard Hanzon, SSRN, 2014)[4]. In doing so, we follow very closely the Johansen approach for the VAR case; see Johansen (1995). Finally, the remaining free parameters will be represented using a new local parametrization technique which has several advantage,and we show how efficient gradient-type algorithms can be employed for the numerical optimization in the resulting lower dimensional unconstrained problem. Simulation studies and applications will be presented.

References

[1] R.F. Engle and C.W. Granger, Co-integration and Error Correction: Representation, Estimation and Testing, Econometrica (1987)

[2] P.C.B. Phillips, A Constrained Maximum Likelihood Approach to Estimating Switching Regressions, Journal of Econometrics(1991).

[3] S. Johansen, Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models, Econometrica(1991).

[4] T. Ribarits and B. Hanzon, The State-Space Error Correction Model: Deffinition, Estimation and Model Selection,(SSNR),2014.

[5] T. Ribarits and B. Hanzon, On a New Approach to Cointegration - The State-Space Error Correction Model.

[6] B. Hanzon and T. Ribarits, Co-integration in Continuous and Discrete Time - The State-Space Error-Correction Model.

Modelling of fold-type oscillation mark formation in continuous steel casting

Kevin Devine[a], **Michael Vynnycky**[b], **Stephen O'Brien**[a], **Sarah Mitchell**[a], **Brendan Florio**[c]

[a]Mathematics Applications Consortium for Science and Industry (MACSI),
Department of Mathematics and Statistics
University of Limerick, Castletroy, Limerick, Ireland
kevin.devine@ul.ie, stephen.obrien@ul.ie, sarah.mitchell@ul.ie, brendan.florio@ul.ie

[b]Division of Casting of Metals, Department of Materials Science and Engineering,
KTH Royal Institute of Technology, Brinellvägen 23, 100 44 Stockholm, Sweden
michaelv@kth.se

[c]CSIRO Mineral Resources, Waterford, 6152, Western Australia and School of Mathematics and Statistics, University of Western Australia, Crawley, Western Australia 6009, Australia
brendan.florio@graduate.uwa.edu.au

ABSTRACT

Continuous casting has been developed industrially worldwide since the 1950s as a high-throughput method for producing, amongst other things, metal billets, blooms and slabs; more than 90% of the world's steel is produced this way, amounting globally to more than one billion tonnes of steel cast per year. During casting, liquid steel is poured into the top of a water-cooled copper mould, where intense cooling causes a solidified steel shell to form. To prevent the steel sticking to the mould wall, a flux powder is added to the surface of the steel and the mould is oscillated at high frequency; the process is further complicated by low frequency phenomena associated with the turbulent flow of molten steel and the meniscus level fluctuations. All of these combine to produce undesired imperfections on the steel surface, which are expensive to remove, and a process that is both difficult to predict and control.

We revisit the work done by Hill et al. [2], which builds on earlier work [1], in order to formulate our model which is more amenable than some numerical models [3, 4, 5, 6]. We use a lubrication approximation in the liquid flux region. Heat flow in the steel and flux is considered and coupled with the flow equations to predict mark formation. The model is non-dimensionalised in a systematic way, neglecting many of the assumptions made in [2]. We obtain what we believe to be the correct asymptotic model. We defer the numerical analysis arising from this model. We then proceed with our analysis by relaxing some dimensionless parameters. Thus a qualitative result is obtained.

A further analysis is then completed in order to provide a definitive conclusion on the effects of three key quantities: the heat transfer coefficient, the thermal contact resistance and the dependence of the viscosity of the flux powder as a function of temperature.

Acknowledgement

This work has been performed within the Swedish Energy Agency project Reduction of oscillation marks and surface defects in continuously cast materials (grant no. 37976-1), the Mathematics Applications Consortium for Science and Industry (www.macsi.ul.ie) funded by the Science Foundation Ireland grant no. 12/IA/1683 and the Irish Research Council grant no. GOIPG/2014/1147. Funding was also provided by MI-NET grant no. ECOST-STSM-TD1409-160216-070364.

References

[1] J. M. Hill and Y. H. Wu. On a nonlinear stefan problem arising in the continuous casting of steel. *Acta Mechanica*, 107(1-4):183–198, 1994.

[2] J. M. Hill, Y. H. Wu, and B. Wiwatanapataphee. Analysis of flux flow and the formation of oscillation marks in the continuous caster. *Journal of Engineering Mathematics*, 36(4):311–326, 1999.

[3] A. S. M. Jonayat and B. G. Thomas. Transient thermo-fluid model of meniscus behavior and slag consumption in steel continuous casting. *Metallurgical and Materials Transactions B: Process Metallurgy and Materials Processing Science*, 45(5):1842–1864, 2014.

[4] P. E. Ramirez-Lopez, P. D. Lee, and K. C. Mills. Explicit modelling of slag infiltration and shell formation during mould oscillation in continuous casting. *ISIJ International*, 50(3):425–434, 2010.

[5] P. E. Ramirez-Lopez, P. D. Lee, K. C. Mills, and B. Santillana. A new approach for modelling slag infiltration and solidification in a continuous casting mould. *ISIJ International*, 50(12):1797–1804, 2010.

[6] P. E. Ramirez Lopez, K. C. Mills, P. D. Lee, and B. Santillana. A unified mechanism for the formation of oscillation marks. *Metallurgical and Materials Transactions B: Process Metallurgy and Materials Processing Science*, 43(1):109–122, 2012.

Posters

Groupoid technique for data analysis

Nisreen Alokbi

National University of Ireland, Galway
nisreen.alokbi@gmail.com

ABSTRACT

Mapper is a clustering technique for modelling geometric and topological properties of metric spaces based on finite random samples. We enhance the output of the standard Mapper procedure so as to capture, in an easily interpreted format, 2-dimensional homotopy theoretic information about the input data. As part of the enhancement we describe a method for performing a parallel computation of the cohomology cup product $H^1(Y) \times H^1(Y) \to H^2(Y)$ for a finite regular CW space Y . In our intended application Y is a model of point cloud input data. We use the theory of finitely presented groupoids to implement our enhancement of Mapper.

Application of State Space models in Financial Mathematics

Miaad Alqurashi

University College Cork
mhqurashi@windowslive.com

ABSTRACT

In dynamic modelling of financial and economic data the concept of cointegration plays an important role. It refers to the existence of long-term equilibrium relations between financial/economic variables in a dynamic environment. In the literature so-called VAR models with cointegration are popular.In its Edgeworth Center, University College Cork are developing parameterization/estimation methods for alternative models, namely State Space models with cointegration. The research topic in this project is to study cointegration of financial data and how a state space representation of these processes exists and . We will first start off by giving a brief introduction on cointegrated I(1)processes before moving onto the more widely used models. After laying out the groundwork of the Engle and Granger approach and of Johanson's work using the VAR model WE will consider how a state space representation of the cointegration model using a maximum likelihood criterion can be beneficial as opposed to Johanson's VAR model.By the end, we will look at how we can estimate the parameters of the State Space Error Correction Model (SSECM).

Numerical simulations of drumlin formation

James Fannon

University of Limerick
james.fannon@ul.ie

ABSTRACT

Drumlins can be loosely defined as small oval-shaped hills that are found in regions that were once covered by ice sheets. They are a ubiquitous natural phenomenon, with so-called drumlinized terrain estimated to account for up to half of Irelands land area. This work summarizes the present form of the instability theory for drumlin formation, which describes the coupled subglacial flow of ice, water and sediment. This model has evolved considerably over the last 20 years, and is now at the point where it can predict instabilities corresponding to drumlins and related subglacial bedforms known as ribbed moraine and mega-scale glacial lineations. While efforts to perform numerical simulations using previous versions of the theory have been limited, we present a new numerical method to solve the current model and demonstrate that simulations can be obtained for realistic values of most of the model parameters. Our results indicate that three-dimensional bedforms of the correct size arise which can resemble ribbed moraine, drumlins, and lineations, while we also explore to some extent how the solutions depend on the model parameters.

Modelling the efficiency of nanofluid-based solar collectors

Gary O'Keeffe

University of Limerick
gary.okeeffe@ul.ie

ABSTRACT

In this poster, I will present models for predicting the efficiency of different types of nanofluid-based solar collectors. Generally, these models will consist of a system of equations: partial differential equations (PDEs) describing the conservation of energy and momentum, and a radiative transport equation describing the propagation of radiation through a nanofluid. I will briefly talk about dimensional analysis, and I will also discuss both analytic and numerical solutions to the conservation of energy PDEs.

List of Participants

Daher	Al Baydli	NUI Galway	daher.mathematics@gmail.com
Ghadeer	AlBalawi	Dublin lnstuite of Technology	ghadeervip01@gmail.com
Nisreen	Alokbi	NUI Galway	nisreen.alokbi@gmail.com
Faiza	Alssaedi	NUI Galway	f.alssaedi1@nuigalway.ie
Miaad	Alqurashi	University College Cork	mhqurashi@windowslive.com
Nicole	Beisiegel	University College Dublin	nicole.beisiegel@ucd.ie
Richard	Burke	NUI Galway	richardburke8@gmail.com
Hannah	Conroy Broderick	NUI Galway	h.conroybroderick1@nuigalway.ie
Kevin	Devine	University of Limerick	kevin.devine@ul.ie
Cliona	Donnelly	NUI Galway	clionaedel@gmail.com
Catherine	Enright	Valeo Vision Systems	catherine.enright@valeo.com
Lida	Fallah	NUI Galway	l.fallah1@nuigalway.ie
James	Fannon	University of Limerick	james.fannon@ul.ie
Patrick	Fleming	NUI Galway	p.fleming3@nuigalway.ie
Roberto	Galizia	NUI Galway	r.galizia1@nuigalway.ie
Samuel	Geraghty	NUI Galway	s.geraghty14@nuigalway.ie
Paul	Greaney	NUI Galway	paul.greaney@nuigalway.ie
Róisín	Hill	NUI Galway	r.hill2@nuigalway.ie
Aoife	Hill	NUI Galway	a.hill5@nuigalway.ie
Niall	Madden	NUI Galway	niall.madden@nuigalway.ie
Vinh	Mai	NUI Galway	q.mai1@nuigalway.ie
Robert	Mangan	NUI Galway	r.mangan4@nuigalway.ie
Chris	Marshall	NUI Galway	c.marshall1@nuigalway.ie
Faik	Mayah	NUI Galway	faik.mayah@nuigalway.ie
Niall	McInerney	University of Limerick	mackard57@gmail.com
Martin	Meere	NUI Galway	martin.meere@nuigalway.ie
Hanan	Mohammed	Dublin Institute of Technology	d16124005@mydit.com
Sai Abinesh	Natarajan	NUI Galway	s.natarajan3@nuigalway.ie
Cian	O'Brien	NUI Galway	c.obrien40@nuigalway.ie
Joey	O Brien	University of Limerick	Joseph.obrien@ul.ie
Christopher	O Connor	University College Cork	christopherconnor22@outlook.com
Gary	O'Keeffe	University of Limerick	gary.okeeffe@ul.ie
Paul	O'Keeffe	University College Cork	paulokeeffe@umail.ucc.ie
Mario	Quarenta	NUI Galway	mrquarenta@gmail.com
Qays	Shakir	NUI Galway	q.shakir2@nuigalway.ie
Griffen	Small	NUI Galway	g.small1@nuigalway.ie
Kirk	Soodhalter	Trinity College Dublin	ksoodha@maths.tcd.ie
Eoghan	Staunton	NUI Galway	eoghan.staunton@nuigalway.ie
Samyukta	Venkataramanan	Dublin Institute of Technology	samyukta.venkat@gmail.com
Shane	Walsh	University College Dublin	shane.walsh.3@ucdconnect.ie
Michael	Welby	NUI Galway	m.welby5@nuigalway.ie