INVITATION LETTER

JOINT RESEARCH SEMINAR BETWEEN RMIT & UNIVERSITY OF SCIENCE, VNU-HCM

TOPIC: AI FOR ADVANCED PROCESSING_ FROM SPEECH AND VISION TO MULTI-SCALE COMPUTATIONAL MODELLING.

Hochiminh City, 15th July 2022

The School of Science, Engineering & Technology (SSET), RMIT Vietnam and University of Science, VNU-HCM Vietnam would like to invite you to our joint Research Seminar: **AI for Advanced Processing: from Speech and Vision to Multi-scale Computational Modelling.**

There will be 04 speakers, invited guests:

- **Assoc Prof Minh-Triet Tran**, University of Science, VNU-HCMC Vietnam will present the Vision-based Smart Interaction System.
- **Dr Son Tran**, University of Science, VNU-HCMC Vietnam will present the Speech enhancement application using a variational autoencoder.
- **Dr Khiem Nguyen**, University of Glasgow, UK will present the application of neural networks to constitutive modelling of multi-scale materials.
- **Dr Cuong Tan Nguyen**, SSET, RMIT Vietnam will present a data-driven approach to gradient elasticity, phase-field modelling and two time-series forecasting approaches: a statistical method namely ARIMA and a neural network learning-based method, namely LSTM for fracture problems.

Date & Time: Friday 15 July 2022; 3pm-6pm
Venue: RMIT Saigon South Campus (702 Nguyen Van Linh, D7, HCMC) & online mode via Teams.

Registration:

https://forms.office.com/r/iRhJ9UK7qE

Agenda:

No	Time (VN)	Content	PIC/ Presenter
1	3.00pm-3.10pm	**Welcome speech**	Prof Brett Kirk - SSET, RMIT Dr Alexandru Fechete - SSET, RMIT
2	3.10pm-3.35pm	**Introduce the 1st presenter** **Research Presentation from VNU-HCMUS**	Dr Alexandru Fechete - SSET, RMIT Dr Son Tran - VNU HCMUS
3	3.35pm-3.40pm	**Q&A**	Dr Alexandru Fechete - SSET, RMIT
4	3.40pm-4.05pm	**Introduce the 2nd presenter** **Research Presentation from VNU-HCMUS**	Dr Alexandru Fechete - SSET, RMIT Dr Triet Tran - VNU HCMUS
5	4.05pm-4.10pm	**Q&A**	Dr Alexandru Fechete - SSET, RMIT
6	4.10pm-4.20pm	**Tea Break**	
7	4.20pm-4.45pm	**Introduce the 3rd presenter** **Research Presentation from University of Glasgow**	Dr Alexandru Fechete - SSET, RMIT Dr Khiem Nguyen - University of Glasgow, UK
8	4.45pm-4.50pm	**Q&A**	Dr Alexandru Fechete - SSET, RMIT
9	4.50pm-5.15pm	**Introduce the 4th presenter** **Research Presentation from RMIT**	Dr Alexandru Fechete - SSET, RMIT Dr Cuong Nguyen, SSET, RMIT
10	5.15pm-5.20pm	**Q&A**	Dr Alexandru Fechete - SSET, RMIT
11	5.20pm-5.25pm	**Closing speech**	Prof Brett Kirk - SSET, RMIT
12	5.25pm-6pm	**Networking event**	

Please kindly register for the event at the above link so that we can send detailed information & presentation abstract to you.

Presenters:

Assoc Prof Minh-Triet Tran (Member, IEEE) received the B.Sc., M.Sc., and Ph.D. degrees in computer science from University of Science, VNU-HCM, in 2001, 2005, and 2009. In 2001, he joined University of Science. He was a Visiting Scholar with the National Institutes of Informatics (NII), Japan, from 2008 to 2010, and the University of Illinois at Urbana–Champaign (UIUC), from 2015 to 2016. His research interests include cryptography, security, computer vision, and human–computer interaction. He is currently the Vice President of University of Science, VNU-HCM, and Director of John von Neumann Institute, VNU-HCM. He is also Membership Development, Student Activities Coordinator of IEEE Vietnam. He is also a member of the Advisory Council for Artificial Intelligence development of Ho Chi Minh City, and Vice President of Vietnam Information Security Association (VNISA, South Branch)

Dr Son Tran received the bachelor's degree in science from the Faculty of Information Technology, University of Science, VNU-HCM, Vietnam in 1997, and the Ph.D. degree in engineering from the Department of Electrical and Computer Engineering, Toyota Technological Institute, Japan, in 2005. From 2005 to 2010, he was a Researcher of smart vehicle projects with Toyota Technological Institute, Japan. He is currently a Lecturer with the Faculty of Information Technology, University of Science, VNU-HCM. His research interests include machine learning, image processing, speech processing, and computer vision.

Dr Khiem Nguyen obtained Bachelor in Mathematics (Vietnam National University), Master in Computational Engineering (Ruhr University of Bochum; RUB) and Ph.D. in Applied Mathematics (RUB). Prior to working in Glasgow, he worked for more than five years in Civil Engineering and Mechanical Engineering at the University of Stuttgart, Helmholtz Research Center for Materials Science and ETH Zurich. He joined the University of Glasgow as a lecturer in Multiscale Materials in January 2022.

Dr. Cuong Tan Nguyen received Master in Science and Ph.D. degrees in Mechanics Uncertainty, and Simulation in Engineering from the University of Texas at Austin. His research expertise is in computational mechanics, data-driven computing and applications of machine learning in applied mechanics. Dr Cuong's recent research projects are in developing a data-driven framework for non-local materials simulation, machine learning pipeline for phase-field modelling of fracture problems, transformed Newton's method with fixed-point iteration for highly nonlinear problems, and a non-destructive testing method for pre-stressed level inversion in elastic rods.

Abstract:

	Presenter	**Title**	**Abstract**
1	Assoc Prof Minh-Triet Tran	Vision-based Smart Interaction	Collecting and analyzing daily activity logs can provide potential insights for better understanding and possible optimization for individual and organizational activities and operations. There are multiple sources to gather information in various formats during daily activities. People usually post photos, video clips, or messages to their social channels everyday. People may record their daily activities with wearable cameras or other types of sensors. Millions of surveillance cameras capture various events in traffic systems, offices, or supermarkets. It is an increasing demand to process and analyze such information, mostly in visual format, to develop useful services and utilities for smart environments. In this talk, we present several modalities to analyze and interact with daily activity logs to develop potential applications for smart environments. Our proposed systems are based on practical social needs and aim to provide people natural experience with smart services and utilities. - People can access to augmented data and services for tourism or shopping by recognizing the current context and retrieving similar known cases. - Lost items can be found or memories can be retrieved or verified by searching daily logs. - Reminiscence can help people to positively revive past memories and connections with their relatives. - Regular events and anomalies can be detected from surveillance systems for appropriate actions. - Event simulation in virtual or mixed reality environments can be generated from real life data for education and training. We also discuss about privacy and security issues in collecting and analyzing daily activity logs.

2	Dr Son Tran	Speech enhancement using a variational autoencoder	Speech enhancement is essential for speech-related applications because this process improves the quality of input speech signals before processes in the primary model. Most of the current approaches for this task focuses on separating the speech of commonly high-frequency noises or a particular background sound. They cannot remove the signals which intersect with the human speech in its frequency range. We propose a hybrid approach combining a variational autoencoder (VAE) and a bandpass filter (BPF) to deal with this problem. This method can extract and enhance the speech signal in the mixture of many elements such as speech signal, high-frequency noises, and many kinds of different background sounds which interfere with the speech sound. Experimental results showed that our model could effectively extract the speech signal in terms of Signal interval ratio and Signal to Distortion Ratio. On the other hand, we can adjust the passband to identify the frequency range at the output signal to apply for a particular application like gender classification. In the following research, we will emphasize the impact of a variational model on the whole process. A general class for VAE, called Dynamical Variational Autoencoder (DVAE), will extract the primary elements that contribute to the most content of the signal. Mainly, DVAE is a general form of traditional VAE that uses many modern techniques such as recurrent connection, attention, drop out, Etc., for both Encoder and Decoder networks. We design a new architecture in DVAE class to exploit the structure of a signal frame in the frequency domain. Our motivation for this work is that the human brain can easily extract and understand a piece of speech even in a noisy environment. A potential cause is that human speeches establish a structural form in the frequency domain. This aspect of human speech has never been mined before, and we hope that our new solution could improve the current state of the art solution for the speech enhancement problem.

3	Dr Khiem Nguyen	Application of neural networks to constitutive modelling of multi-scale materials.	We propose a surrogate model for two-scale computational homogenization of elastostatics at finite strains. The macroscopic constitutive law is made numerically available via an explicit formulation of the associated macro-energy density. This energy density is constructed by using a neural network architecture that mimics a high-dimensional model representation. The database for training this network is assembled through solving a set of microscopic boundary values problems with the prescribed macroscopic deformation gradients (input data) and subsequently retrieving the corresponding averaged energies (output data). Therefore, the two-scale computational procedure for the nonlinear elasticity can be broken down into two solvers for microscopic and macroscopic equilibrium equations that work separately in two stages, called the offline and online stages. A standard finite element method is employed to solve the equilibrium equation at the macroscale. As for microscopic problems, an FFT-based collocation method is applied in tandem with the Newton-Raphson iteration and the conjugate-gradient method. Particularly, we solve the microscopic equilibrium equation in the Lippmann-Schwinger form without resorting to the reference medium and thus avoid the fixed-point iteration that might require quite strict numerical stability condition in the nonlinear regime.

4	Dr Cuong Nguyen	Data-driven approach to gradient elasticity and time-series forecasting for phase-field modelling of fracture problems	Traditional simulations in computational modelling of engineering materials rely on two very different types of equations. The first one is about universal laws such as conservations of mass, momentum and energy, whereas the second one is related to material models which are calibrated from experimental material data. It is well-known that the second type of equation contains modeling errors and often fails to match new experimental findings. In order to take advantage of data science, experimental data sets are used directly in simulations. We try to minimize the distance between the phase-space derived from universal laws and the cloud of data points obtained from experiments. This approach was first introduced by Prof. Ortiz from Caltech. In this talk, we present our extension of this paradigm to deal with nonlocal response of nanostructures such as carbon nanotubes and graphene-based nanodevices. Fracture is one of the most typical failure modes of many natural and human-made materials such as concrete, rock, ceramic, metals and biological soft tissues. In order to predict crack initiation and propagation efficiently, the phase-field paradigm has gained significantly popularity over the past decade. Using the phase-field variable helps us to model the crack propagation process without undergoing the mesh refinement of finite element models. However, the main drawback of phase-field modelling lies in the expensive computational cost due to the requirement of using sufficiently fine meshes. To predict faster the results of fracture problems, we combine a phase-field model with a time-series forecasting method. Specifically, in order to build a forecasting machine learning pipeline, we utilize two time-series forecasting approaches: a statistical method namely ARIMA and a neural network learning-based method, namely LSTM.

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