POSTGRADUATE OPPORTUNITIES AT FACULTY OF MECHANICAL ENGINEERING, UTeM

TITLE	MATHEMATICAL MODELLING OF CORROSION IN STEEL IMMERSED IN AQUEOUS ALKALINE SOLUTION USING NERNST-PLANCK EQUATIONS
PROJECT SUMMARY	Modelling of corrosion processes has attracted increasing interest in the environmental field. Metal loss during corrosion is basically the result of interaction between materials and their environment and is destructive to nature and the environment. This results in structural failure and great economic loss to the country. Corrosive environments include the existence of factors such as air, humidity, water (e.g. fresh, salt, marine, distilled), hydrogen chloride in marine environment, acids, alkalis, etc. Corrosion damage may result in hazards to nature and the environment, due to loss of products (or leakages), efficiency and contamination. The main motivation of this research is to construct and integrate complex mathematical relations, to study the evolution/propagation of a single pit in steel and to predict pit shapes. In view of the chemical and electrochemical reactions inside a pit, the electrolytes activities, namely diffusion and migration, require ionic current consideration and this is governed by the Nernst-Planck equation. A three-dimensional model that can predict pit evolution in aqueous sodium chloride solution is to be developed. This model incorporates mathematical equations used to construct a Pourbaix diagram for iron to govern active-passive metal behaviour, a key phenomenon in corrosion process. COMSOL-Multiphysics runs together with Chemical-Reaction-Engineering-Module and Corrosion-Module to solve the Nernst-Planck equations for mass transport and potential variations. At a time range, this model can capture ionic species migration and geometric boundaries movement, allowing corrosion rate and pit shape predictions. This state-of-the-art software will definitely support the theoretical advances in this research, besides feeding the practical advances in corrosion science and engineering, and other engineering fields particularly oil and gas, material engineering/selection and manufacturing industries. The theoretical advances constructed, together with the model's dynamic properties, will exert an important feature in understanding corrosion protection and thus, reducing cost of maintenance and protection to the environment.
RELATED FIELD	*mathematical modelling, corrosion*
CONTACT PERSON	*Email:* suhaila@utem.edu.my; *Cellphone number:* +60192721729

TITLE	Numerical simulation of blood flow on the risk of cardiovascular heart valve thrombosis using computational fluid dynamics
PROJECT SUMMARY	Cardiovascular disease (CVD) remains the leading cause of death, accounting for more than 17.3 million deaths per year reported in 2017 worldwide. Its represents 31 % of all global deaths, a number that is expected to grow to more than 23.6 million by 2030. One of the causes of CVD is associated with the malfunction of heart valves. Unrepaired valves necessitate surgery so that the artificial heart valve's replacement can be done. It is estimated that more than 300,000 replacement heart valves are implanted annually worldwide. Computational fluid dynamics (CFD) simulations are becoming a reliable tool in understanding disease progression, investigating blood flow patterns and evaluating medical device performance such as mechanical heart valves (MHV). The non-physiological flow pattern (i.e. recirculation, stagnation, and vortex dynamics) might cause a trapped platelet and be responsible in the formation of blood clots or so-called thrombus in MHV. Accumulation of thrombus will make the MHV malfunction, while detached thrombus if it goes into the brain will cause stroke or sudden death. Therefore, this project is proposed to reduce the non-physical flow (vortex dynamic) through the novel MHV leaflet design merely using numerical simulation method. Human patient specific imaging data collaborated with Serdang hospital will be use in this project. Student embark in this project must be registered as a full-time postgraduate student at Faculty of Mechanical Engineering, UTeM leading to Master of Science (MSc) in Mechanical Engineering for 2-years (2019-2020). The project is under the Fundamental Research Grant Scheme (FRGS) from the Ministry of Education, Malaysia. Successful candidate will be given around RM1,500-1,800 monthly allowance. Requirement: i) Bachelor degree in Mechanical/Aerospace/ Automotive/Biomedical Engineering (or other relevant degree); ii) CGPA above 2.9/4.0; iii) Basic knowledge in Computational Fluid Dynamics (will be given) and preferably has experience in Open FOAM (or any CFD) software. For more details, please contact Dr. Mohamad Shukri Zakaria (mohamad.shukri@utem.edu.my) or call 017 7225414.
RELATED FIELD	*Mechanical, Computing, Biomechanics,Aerospace, Manufacturing*
CONTACT PERSON	Emel: *mohamad.shukri@utem.edu.my* *Hp: 0177225414* Website: *www.mohamadshukri.com*

POSTGRADUATE OPPORTUNITIES AT FACULTY OF MECHANICAL ENGINEERING, UTeM

TITLE	DISCRETE-TIME SYSTEM MODEL IDENTIFICATION USING GENETIC ALGORITHM WITH SINGLE PARENT CROSSOVER TECHNIQUE
PROJECT SUMMARY	This project focuses on the field of system identification. Even though genetic algorithm has become more and more frequently preferred as optimization method within the field, the efficiency of identification is still lacking. This may be observed from long processing time and incorrect model selection when simulated (known) model is used. A reason for this lack of efficiency is that common crossover operators of genetic algorithm select the parents from a pool of random individuals, regardless of their similarities. A new crossover type will be developed and tested through computer simulation using software MATLAB. The term single-parent crossover is used as the new crossover operation consists of two individuals where individual 1 (now, parent 1) is made of completely opposite characteristic of the single parent (now, parent 2). The simulation will be carried out using binary-coded genetic algorithm where parent 1 can be developed in the form of inversion of the binary number carried by parent 2. Several simulated and real data will be generated, first, and system identification, assuming regression model type, using the new crossover will be carried out on these data. Comparison will be made based on accuracy of selected model, processing time and quantitative exploration of search space to other crossover types, such as single-point, two-point, multi-point and uniform crossover. It is expected that, with this crossover, the "marriage" of these parents will more likely be able to explore new search space of solution, thus more varied offsprings, that cannot be achieved by common crossover operators. The output of the project is system identification using an improved crossover technique as compared to other conventional ones. Such achievement will allow a more optimized identification.
RELATED FIELD	*Mechanical Engineering, Genetic Algorithm*
CONTACT PERSON	*DR MD FAHMI BIN ABD SAMAD @ MAHMOOD* *mdfahmi@utem.edu.my* *062704357*