Preface

This special issue on Underwater System Technology are gathered from submitted related to the area of underwater vehicle development, system modelling and control, and also the development of various underwater sensors. The papers in this issue cover various recent developments related to the field of underwater system technology from various research groups around the globe. This is a positive development indicating a renewed interest in R&D related to the exploitation of the marine resources.

The paper on "*3D Reconstruction of Seabed Surface through Sonar Data of AUVs*" by Zhang *et. al.* describes the development of an Autonomous underwater vehicles (AUVs) which are widely used to explore the mysterious underwater world. Through following along predefined spatial paths, AUVs are able to gather valuable seabed information in a designated area by recruiting sonar suites, and the acoustic data collected are usually in the type of point cloud with range information. Hence, allowing the reconstruction of the date into a 3D seabed map. The paper also presents a practical mesh method to achieve an accurate reconstruction of seabed surface from raw sonar records. The sonar data processing consists of three stages: point clearing, point normal and 3D surface reconstruction. Simulation results show the effectiveness of the proposed approach. The next paper is on the modelling and analysis of an AUV-typed platform entitled "*Buoyancy-Driven Underwater Glider Modelling and Analysis of Motion Control*" by K. Isa and M. R. Arshad. This paper describes the modelling of USM underwater glider which can be driven either by using buoyancy or propeller. The main problems of controlling the glider are high nonlinearity of the dynamics and disturbances from the water currents. Thus, this paper presents a mathematical model and motion control analysis for a buoyancy-driven underwater glider with presences of water currents.The model of the glider was based on Newton-Euler method, while the hydrodynamics effects were estimated based on Slender-body theory. The simulation results show that the model is controllable and stable, and the LQR control approach produced better control performance than the state feedback method.

The third paper by M.N. Mat Nawi *et.al.* talks about the "*Development of Biomimetic Flow Sensor based on Artificial Lateral Line Flow Sensor for Underwater Applications*". In this paper the function of the artificial lateral line flow system in the fish body is utilised in order to monitor the surrounding for manoeuvring especially under poor visual conditions. This system consisted of the canals neuromast and superficial neuromast. This paper presents the development of superficial neuromast and concentrates on the fabrication method and measurement system. A sensitivity of 0.26 $mV/ms^{-1}$was obtained for the sensor based on the applied flow rate and output voltage. The experiment of moving object detection have been demonstrated where it enables to detect the moving object at close range of about 2cm. Another sensor-related paper by M. I. H. Yaacob *et.al.* entitled *"Enhancement of Piezoelectric Micromachined Ultrasonic Transducer using Polymer Membrane for Underwater Applications"* describes the effort to enhance receiving response of piezoelectric micromachined ultrasonic transducers (pMUT) at low frequency was reported. PMUTs were fabricated with the vibrating membrane formed by a layer of polydimethylsiloxane (PDMS) polymer. While, lead zirconatetitanate, Pd $(Zt,Ti)O_3$ (PZT) was utilized as the piezo-active layer, sputtered with nickel electrodes. Spin coating and low temperature wafer bonding were proposed as part of the key fabrication methods. Analyses revealed the maximum receiving response was -36.6 dB re 1V of 200 kHz burst at 10 λ hydrophone-projector separations and 20 V peak to peak of drive voltage on reference projector. Finally, response spectrum of the transducer was plotted against two commercialized bulk hydrophones at equivalent frequency band for validation and comparison. Another paper on sensor development and modelling is by M.F.A.Rahman *et. al*. entitled *"An Investigation On The Behaviour Of PDMS As A Membrane Material For Underwater Acoustic Sensing"* investigates the behaviour of Polydimethylsiloxane (PDMS) as a vibrating membrane for acoustic signal detection application. The modelling and simulation work was performed using ANSYS 12.1. The theory of acoustic impedance showed that PDMS acting as an acoustic membrane is acoustically matched when operated in water rather than air with 96.7%

energy transfer efficiency. The effect of hydrostatic pressure on the membrane deflection was studied for a very shallow application with depth level ranging from 0 to 1m. The effect of PDMS structural geometry on its deflection behaviour was also studied by varying the radius and thickness of the membrane structure. Finally, according to the deflection theory, the type of membrane deflection was classified based on the variation of radius to thickness ratio of the membrane as well as the applied pressure.

The next paper in the issue talks about *"Diagnosis of thruster fault condition using statistical design of experiment"*. This is a paper by M.A.M. Yusof *et. al*. which presents the diagnosis of thruster fault condition using statistical design of experiment. Fault in thruster can cause deviation in process parameter, i.e. current load which could interfere with the propulsion system and overall system operation. The faulty conditions are demonstrated by blocked ducting. And, the variations of current load due to several conditions e.g. normal and faulty are studied using analysis of variance (ANOVA) and factorial design. The results from the experiment showed that the null hypothesis H_0 for both Two-Factor factorial design and Tukey's test are rejected and the alternate hypothesis H_1 is accepted. This indicates that the current loads for each pair are varying and all means in thruster condition factor are significantly different. On another note, the paper by D.G.Garcia *et. al.* entitled *"Wave filtering for heading control of an AUV based on passive observer"* elaborates on the heading control of an AUV which is improved in order to counteract the undesirable effect of the waves in the actuators system. The wave filter suggested is a linear passive observer and includes features like estimation of both the low frequency heading and heading rate of the vehicle from noisy measurement of an Inertial Measurement Unit, removing the oscillatory component. The experimental results confirm the suitable filtering, the estimating properties of the observer and the navigation response expected, reducing control action and thus vibrations of the rudder. This is followed by a paper entitled *"A Discontinuous exponential stabilization of chained form system for an X4-AUV"* by Z.M.Zain *et. al.* In this paper, an underactuated control method is considered for an X4-AUV with four thrusters and 6-DOFs. A second-order chained form transformation is introduced to the dynamical model by separating a system into three parts of controller model. Then, the Astolfi's discontinuous control method is applied to realize an underactuated control method to stabilize the system. This approach is motivated by the fact that the discontinuous dynamic model without using a chained form transformation assures only a local stability (or controllability) of the dynamic based control system, instead of guaranteeing a global stability of the system.

The following are selected papers from ICIUS2011. Among them is a paper by Abidin *et. al* which covered the issue of virtual simulation of Autonomous Surface Vessels (ASVs) named, Drosobots, using virtual simulation software i.e. Webots™, and the pre-deployment in a swimming pool environment based on an improved navigation technique. In the study, the performance of the system was determined by firstly, its capability to allow the various robots to communicate amongst themselves in order to reach the desired location and secondly, the use of optimization in its searching strategy. By using basic theories of GPS steering, low-cost microcontroller and straightforward wireless communication method, a framework which takes into consideration both mechanical constraints in its physical setup and the suitability of control methods was presented. Muljowidodo *et. Al* presented the design method for modular composite hull of a hybrid autonomous underwater vehicle. The step by step method to design the modular composite drybox hull was described and discussed. The FEA (Finite Element Analysis) for material strength analysis was used to optimize and find the most efficient layer number and good safety factor for the composites drybox. On the other paper, Muljowidodo *et. al* presented the design and operation analysis of flying catamaran USV. The design was focused on the propulsion and distribution of hydrodynamic and aerodynamic loads on the vehicle where in computational fluid dynamics method was used as the main analysis tool. Kaliappan *et. al* studied the use of Hardware-In-the-Loop Simulation (HILS) for the control validation of autonomous underwater vehicle. The setup of the simulation environment both of the software and hardware components was described and the benefit of the system highlighted.

The selected papers in this issue are intended to disseminate the latest development in the respective research topics. Finally, the editors would like to express their sincerest gratitude to all contributing authors for the hard work in preparing and revising the manuscript. We wish the readers find the special issue not only stimulating but also useful and beneficial for their on-going research activities.

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Guest Editors