

Letter of Motivation

Dear Dr. Vasso Reppa and Prof. R.R. Negenborn,

This is Yaolin GE, a final year master student from Maritime Engineering subject at KTH Royal Institute of Technology, currently applying for the doctoral programme in “Robust and Adaptable Control Systems for Effective Ship Automation” at TU Delft. I would like to explain as follows my motivation for my application, and my previous experiences related to this field for your consideration.

Thanks to the swift progress of my bachelor's degree, it is glaring that studying and doing research are endeavours I would like to engage in even more. While studying for my BSc in Naval Architecture and Ocean Engineering at Jiangsu University of Science and Technology (JUST), not only did I develop a systematic way of solving existing problems in the marine field, but also I did step forward to pursue unsolved problems to reflect on. For instance, the most memorable thing that I have done in this period is that I did spend a whole month to design and fabricate a small robotic drone individually in my spare time inspired by a DIY workshop when I was still a sophomore, which allured me to dive into the world of smart things. It has defeated me many times in the beginning, but I stepped it over eventually, which led to a huge sense of achievement. I did also push myself hard to explore as much as I can, that dedication brought me a national scholarship and an opportunity to take an exchange study in the UK. That exchange study program at the University of Strathclyde, which I consider did bring great advantages to me from the perspectives of both academic and personal improvements. The courses I have undertaken there covers diverse aspects of naval architecture and marine engineering, of which my favourite ones are *Seakeeping* and *Manoeuvring*, where the seakeeping part gave me the background on the seastate-relevant knowledge, while the manoeuvring part provoked me about the power of the human brain and the computer brain. For example, how the equations of motion can be formulated, in which plenty of hydrodynamic derivatives need to be sorted out via either numerical ways or experimental ways, eventually what surprised me deeply was that it could predict the motion the vessel in a satisfactory way, although heavy mathematics was required. Meanwhile, the study atmosphere there which greatly encouraged independent research and innovative ideas had brought me more confidence on my success in a higher level of study and research abroad.

As a result of the strong interest in exploring at a higher level, I urged myself to learn more under an advanced study environment, for which I then pursued my master's study within Marine Technology at NTNU. The interdisciplinary study and research environment rewarded me a lot in terms of research skills and personal growth. Thanks to the freedom of choosing any optional courses I like. I did follow my passion to brush up my understanding in the field of smart maritime technology. Power electronics and underwater technologies have been undertaken. They did definitely not let me down, I did gain more valuable skills. Namely, I did design a bi-directional DC-DC power converter using IGBTs for an automated power management system which needs to boost up the output voltage level when the energy source (e.g. battery, fuel cell or supercapacitor) is discharging while it needs to step down the voltage level when the energy source is charging. The promising result showed the full capability of the power management system to do its peak shaving job, which is useful when it comes to energy efficiency. That experience enhanced my ability to utilize power electronics to solve practical problems. On the other hand, underwater robotic technologies enriched my underwater robotic control and sensing toolbox, in which the techniques of MBES (multi-beam echo sounder), SSS (side-scan sonar), DVL (doppler-velocity log), CTD profiler, IMU, GPS

have been investigated extensively. The data post-processing of MBES, SSS, DVL as well as CTD were evaluated massively as well. Other than that, underwater vehicles' navigation and positioning together with their related signal processing systems were also studied broadly, such as dead-reckoning and USBL system, EKF, QMF, CMF etc... Furthermore, I was also invited to inspect a virgin wreck site to conduct a seabed survey using LAUV Fridtjof to collect acoustic images of that wreck to be able to support further researches on the goal of confirming the identity of that wreck. I feel much more confident about my research and analytical skills thanks to the experience gained at NTNU. I am now conducting my research by collaborating with the Swedish Maritime and Robotic Centre (SMaRC) to do the signal processing of underwater beacons for AUVs, which is mainly about designing an underwater beacon to satisfy the requirement of underwater navigation and positioning system as well as the requirements for corresponding signal processing systems. It again rekindles my mindset in the autonomous underwater robotics and signal processing field. Through this research experience, I feel more ready and confident in seeking this doctoral program.

As for my passion for robotic control systems, I believe that the summer campus of computer science experience at Peking University might have a say in that. In that training programme, I worked day by day with fellows from all over the world on the same competition which had the objective of letting robots dance with humans. Computer vision, Motion Capture, OpenCV, Deep Learning, Robotics, Cybernetics, again rejuvenate my motivation to a higher level. To summarise what I have done, I applied openpose algorithm to capture the motion of a human dancer, the resultant 2D captured frames were then converted to 3D skeleton frames, which were then mapped to a 17-DOF (degrees of freedom) multi-joint robot dancer named after Yanshee. The performance of the robot dancer was awkward but adorable due to the fact that it has only 17 DOF compared to 27 DOF for just one human hand. This training programme did not only give me a few hands-on experiences on robotics and machine learning, but also expand my horizon and lead a new perspective of solving problems. Although at this moment, I may be remaining a beginner in this area, at least they have bred a seed in my head as the similar one that the small drone did.

With this wide range of experiences, I have gradually developed a liking taste in smart maritime field. In the past year, I have had some interactions with some Ph.D. students within these field, and it has given me a tantalizing glimpse into the life of a graduate student – and it is a life I want to lead. It is also a life I believe I am ready and able to manage. I develop the motivation from the level of responsibility and independence required of a graduate student and relish the opportunity to prove myself at this level. I believe that pursuing a doctoral programme within the Faculty of Mechanical, Maritime and Materials Engineering at TU Delft, will allow me to learn from professors at the top of this exciting field. This doctoral programme will also enable me to pursue my research interests to a much greater depth while also expand my future career opportunities. It is also worth mentioning that joining a community of other like-minded individuals will be a valuable chance for collaboration and personal development. I believe that I am a diligent and highly motivated student and also a well-qualified applicant.

To conclude, I expect to contribute to the practical researches with my professional knowledge and practical skills obtained from this doctoral programme at TU Delft. With full confidence in me as well as the professional training you provide in the program, I believe that my plan will be realized any time soon. Thank you very much for your time and consideration.

Applicant: *Yaolin Ge*

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