## University of Strathclyde Research Visit to Nagasaki University, December 2023

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#### Summary

Staff from the Energy Systems Research Unit, Department of Mechanical and Aerospace Engineering, University of Strathclyde undertook a reciprocal visit to the Department of Mechanical Engineering, Nagasaki University. The visit was initiated through support from the Marine Alliance for Science and Technology for Scotland and the Scottish Government. The purpose of the visit was to follow on to an initial visit by staff from Nagasaki University to the University of Strathclyde, earlier in the year. The objective of this visit was to engage and conclude discussions to deepen a collaborative research relationship in marine renewable energy, specifically tidal energy technology engineering; and to explore the potential of implementation of a bi-lateral student/ researcher exchange program with the focus on marine renewable energies.

#### Introduction

The University of Strathclyde played host to a visit from researchers from the Department of Mechanical Engineering, Nagasaki University during the summer of 2023. The research visit was hosted by the Energy Systems Research Unit (ESRU), Department of Mechanical Engineering in the form of a workshop to share knowledge and understanding in a range of tidal energy engineering research topics. These topics included: tidal resource monitoring using ADCP's; processing and analysis of data to be fully representative of the flow dynamics a tidal rotor will operate within; tidal rotor configurations, blade hydrodynamic profile sensitivity to the tidal flow dynamics; tidal rotor operation at the power capture interface and performance characterisation; power transfer and take off configurations and operations; tidal systems testing practices and performance benchmarking; prototype development and testing; and turbine rotor, power train and take-off scaling and matching optimisation. This sharing of research understanding and experiences between the two research groups identified a number of research areas of common interest and also a willingness to explore and undertake collaborative research in these topics, with comparisons between applications in Japanese and UK coastal waters.

A visit to the Kelvin Hydrodynamic Laboratory was arranged so the visitors could view the research infrastructure used in the physical testing of tidal energy systems being investigated and appreciate the scale of testing capable of being undertaken, as shown in Figure 1.



Figure 1: Test carriage configuration at the Kelvin Hydrodynamic Laboratory

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An action following the initial visit to Strathclyde University was the development and submission of a research travel grant proposal to advance the research relationship and initiate the research collaboration. The focus being computationally analysing tidal rotor configuration, operation and performance evaluation in flows monitored at the Goto tidal test site, close to Nagasaki. This was application was prepared and submitted to the Royal Society of Edinburgh in October 2023.

The Strathclyde visit to Nagasaki took place at the beginning of December 2023. This had objectives of deepening the tidal energy research collaboration between the two research groups; explore opportunities to implement a bi-lateral student/ researcher exchange program with a focus on marine renewables; and identify potential Japan-UK opportunities for securing research funding.

The first part of the visit consisted of a stop over at Seoul to meet with the Asian Wave and Tidal Energy Conference (AWTEC) Board to discuss the potential opportunity of a Strathclyde – Nagasaki contribution to the AWTEC 2024. The discussions evolved to include capturing such a contribution within a guest presentation to showcase and share the Nagasaki University – University of Strathclyde research collaboration on tidal energy systems engineering. This will be followed up over the coming weeks as the management of the conference program evolves.

On arrival at Nagasaki University, a workshop had been organised which captured the current status of tidal energy development in Japan, deployment of tidal technologies at the Goto in-sea test site, and the challenges and focus of tidal energy research activities in Japan. This prompted discussions relating to the existing collaborative research activities, the characterisation of flow conditions relating to the Goto tidal resource, it's impact on the performance of different tidal turbine power capture and transfer interface configurations, and development/ optimisation of technology to maximise energy yields. It was concluded these will be advanced through researcher engagement in the short term, then a researcher exchange activity between the two research groups, once sufficient funding can be secured. A delivery of a collaborative paper submitted to the Asian Wave and Tidal Energy Conference (AWTEC), in Busan, South Korea October 2024 for the reporting of the work was set.

In order to formalise the research collaboration and work towards implementing a wider student/ researcher exchange program between the two respective departments at Nagasaki and Strathclyde Universities, it was agreed to implement a Memorandum of Understanding. This is now being processed by Strathclyde and Nagasaki Universities and will be implemented in early Q1 of 2024. Fortuitously, during the visit to Nagasaki University, information was received informing both research teams their joint application submitted the Royal Society of Edinburgh had been successful. As well as being a point of celebration, this has given additional emphasis to the research collaboration and planning of the bilateral researcher exchange to be undertaken in Q1 and Q2 of 2024 is now underway.



Figure 2: Strathclyde and Nagasaki Colleagues at the Nagasaki Ocean Academy, Nagasaki University

With University of Strathclyde staff having to return to the UK via Tokyo, an opportunity was sought to meet with the British Council, Tokyo to make them aware of the University of Strathclyde-Nagasaki Research Collaboration and learn of potential UK- Japan program funding opportunities. The meeting with the British Council was informative on how it operates in Japan and the range of educational activities they support was presented, together with how these might assist the development of the relationship between Nagasaki University and the University of Strathclyde.

### **Outcomes and Conclusions**

- Agreement reached to formalise and deepen the research collaboration between the Department of Mechanical Engineering, Nagasaki University and the Department of Mechanical and Aerospace Engineering, University of Strathclyde.
- Successful award of a Royal Society of Edinburgh travel grant to Early Career Researchers at Nagasaki and Strathclyde Universities was successful to initiate the research exchange activity within this research collaboration on Tidal Energy.
- Production of a collaborative paper to be presented at the Asian Wave and Tidal Energy Conference, AWTEC 2024, Busan October 2024 has been set as a milestone.
- An MOU is now being implemented between the Department of Mechanical Engineering, Nagasaki University and the Department of Mechanical and Aerospace Engineering, University of Strathclyde to enable deepening of the linkage between the two Departments.
- Implementation of a student/ researcher exchange program between Department of Mechanical Engineering, Nagasaki University and the Department of Mechanical and Aerospace Engineering, University of Strathclyde is now under development.

## Expenditure

The costs associated with two University of Strathclyde staff undertaking the reciprocal research collaboration visit to Nagasaki University is broken down as follows:

UK – Japan/ Nagasaki return flights:	2 x £1030.66	£2,061.32
Two nights hotel in Seoul:	2 x £250 Ex VAT	£600.00
Two nights hotel in Nagasaki:	2 x £130.40 Ex VAT	£312.96
One night hotel in Tokyo	2 x £92.57 Ex VAT	£222.17
Airport Taxi's-	2 x Seoul – Incheon Airport	£98.46
Airport Taxi's-	2 x Nagasaki – Nagasaki Airport	£57.20
Airport Taxi's	1 x Tokyo – Narita Airport	£169.28
	1 x Tokyo – Hanida Airport	£41.26
Subsistence-	1 x Dinner for two – Seoul	£82.73
	1 x Dinner for two – Nagasaki	£33.25
	1 x Dinner for two – Tokyo	£54.68
	1 x Dinner for two – Tokyo	£60.31

Total £3,793.62