

Computational fluid-structure interaction analysis of the Orion spacecraft parachutes.



A MEETING OF GREAT MINDS

Waseda University's joint appointment system **BRINGS TOGETHER THE WORLD'S TOP RESEARCHERS** to amplify its teaching and research impact.

Ranked among Japan's top universities, Waseda University in Tokyo, under the leadership of the university's new president Aiji Tanaka, is enlisting the world's leading scientists and scholars, and sending its researchers abroad. The goal is to elevate its research and teaching to top-tier global status and to build an internationally-connected research community.

A MODEL OF RESEARCH COLLABORATION

A key pillar of that drive for excellence is the university's Joint Appointment (JA) system, which recruits preeminent international academics to undertake joint research, teaching and graduate research supervision at Waseda, while retaining their primary overseas affiliation. This innovative model has already nurtured some remarkable partnerships, most recently in advanced computational flow analysis.

Enter Waseda's Professor Kenji Takizawa, a global trailblazer in computational analysis of the complex interactions between fluids and moving structures. Takizawa's work has applications as diverse as the dynamics of the parachutes for NASA's Orion spacecraft, heat dissipation

from car tyres, and blood flow in the heart. Through the joint appointment of Professor Tayfun Tezduyar from Rice University in the United States, Takizawa has been able to strengthen his long-time connection to his former postdoctoral mentor.

THE EARLY YEARS

"I first met Professor Tezduyar when I was a PhD student," says Takizawa. "At that time, I was working on free-surface flow and fluid-object interaction. I joined Rice in 2007 to undertake research on fluid-structure interaction using the space-time finite element methods developed by Professor Tezduyar. The research was exciting because many of our collaborators, including NASA engineers, really valued our computed results."

The space-time computational methods enable cutting-edge analysis of the interaction between fluids and moving structures. They provide more computational accuracy and application diversity than traditional methods.

When Takizawa took a faculty position at Waseda, he continued to collaborate closely with Tezduyar, who gave

guidance to some of Takizawa's students and interacted with Waseda colleagues. In 2013, Takizawa and Tezduyar, together with Yuri Bazilevs, published the first book to address the state-of-the-art in computational fluid-structure interaction. It seemed only natural for Takizawa to ask Tezduyar to have a joint appointment at Waseda.

"I agreed to pursue that because we both believed that it would make our joint work even stronger," explains Tezduyar. "These days, I come to Waseda when I am not teaching at Rice — roughly six weeks during the winter break and three months in summer."

THERE IS A SENSE THAT THIS IS JUST THE BEGINNING OF THE TEAM'S EXPEDITIONS

RESEARCH EXCELLENCE, NOW AND INTO THE FUTURE

Takizawa and Tezduyar now co-lead the international Team for Advanced Flow Simulation and Modeling (TAFSM), which focuses on computational engineering analysis with advanced flow simulation and modelling methods.

"Motivated by conducting an extraordinary computational flow analysis in applications such as the Orion spacecraft parachutes, heart valves and tyres, we introduced a special method for flows involving contact between moving solid surfaces," says Takizawa. "The contact is a change of topology in the flow domain, which is known to be one of the most computationally challenging classes of problems. This kind of research requires a lot of creative and systematic thinking, as well as powerful computational technologies, such as the space-time methods that we have been advancing."

These novel and powerful techniques have seen the team's research expand rapidly to wind turbines, patient-specific cerebral aneurysms, turbocharger turbines and exhaust manifolds. There is a sense that this is just the beginning.

"The joint appointment has been an encouraging factor in my work with Kenji, giving formal recognition and support to an already-strong collaboration," notes Tezduyar. "It has also encouraged me to support Waseda's educational and research missions beyond what I do with Kenji, and I



Work between Kenji Takizawa (right) and Tayfun Tezduyar has yielded great results.



Computational analysis of the blood flow in the aorta and heart valve.

Waseda University aims to be ranked in the global top 50 by 2032.



am happy to have increased interaction with his great colleagues. We will continue to work on practical, challenging problems that no one else, or very few people, in the world can solve."

THE JOINT APPOINTMENT SYSTEM

Waseda's JA system is designed to encourage and strengthen international collaboration by giving

appointees full use of the environment and resources at Waseda. Appointees typically have one- to three-year contracts and stay at Waseda for at least three months each academic year to undertake both teaching and research, as well as publish collaborative research articles. Travel expenses and accommodation can be arranged, and the university can help provide support

for living expenses in Japan. Waseda currently holds joint appointments with researchers from universities all over the world. Their research topics include mathematical and computational analysis, energy and nanomaterials, empirical analysis of political economy, and Japanese humanities.

The JA system began under the Waseda Goes Global Plan, a ten-year, multimillion dollar project launched in 2014

and funded by Japan's Ministry of Education, Culture, Sports, Science and Technology. Waseda hopes to continue expanding its collaborative research network. ■

