

Experience Notes

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Financed by the Global COE, I have spent nearly three months at Tohoku University in the Experimental Aerodynamic Lab, led by prof. Asai and Dr. Numata, where I have learned about pressure sensitive paint (PSP) methods used there as well as conducted my own research on the topic.

Already in 2009 I met prof. Asai and one of his students, Yorita Daisuke, at a course on PSP held at DLR in Göttingen, Germany, and was invited to apply for the GCOE internship program. A year later I attended the ICFD conference in Sendai and also took the opportunity to visit the Experimental Aerodynamics lab. In my first visit I was indeed motivated as I witnessed how the PSP research was conducted, contrasting to my home university where I, together with my two supervisors are the only ones currently working in this field. After this visit, one more year passed before my internship began.

During my internship, starting at the end of 2011, I have really had the opportunity to learn from an experienced group within the field as well as being able to do my own research with the excellent feedback from the group. I have found it valuable to share experiences with the members of the lab as well as observing a few experiments.

Among those, a delta-wing experiment where a wing was rotated about its axes of symmetry at different angles of attack. Surface pressure was measured using pressure sensitive paint in order to observe a hysteresis phenomenon appearing only at certain angles of attack. This experiment illustrated the methods used for unsteady PSP measurements used at the Asai-lab.

Together with one of the students another unsteady PSP experiment was carried through where one side of a square cylinder was instrumented with PSP. The cylinder was mounted inside a wind tunnel and the periodic detachment of fluid was observed using a high-speed camera. I found it valuable not only to learn, but to also gain this hands-on experience about the methods.

As for my own research; early on in my stay during a discussion with Asai-sensei, the idea of building a dynamic calibration device for PSP took form. Since I have a background in mechatronics we decided that this task would fit me and decided that this would be my main objective during the stay.

We identified a need for a calibration system for PSP in the frequencies ranging from a few to a few hundred hertz, and noted that existing solutions had problems with either high vibrations or low maximum pressures.

The resulting device overcame these problems with the solution of compressing/expanding a volume of air entrapped within a cylinder using a linear electric actuator. With this device we were able to generate sinusoidal pressure signals of several kPa up to two hundred hertz.

A paper is in the making to be submitted to a yet undecided journal on the device itself together with a new calibration method not yet used in the PSP sphere.

To summarize I am very happy with the experiences I have gained during my internship, the research I was able to perform and of course with Asai-sensei as well as his co-workers and students who made my stay fruitful as well as highly enjoyable.

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