Opleiding Werktuigbouwkunde

Universiteit Twente
de ondernemende universiteit

COLLOQUIUM

Conform artikel 4.6.8 van het SSNS-wb.

Vakgroep: **Technische Stromingsleer**

In het kader van zijn doctoraalopdracht zal

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een voordracht houden getiteld:

Immersed Boundary Method: On Application to Flapping Membrane Wings

Datum: Dinsdag 22-12-2009

Tijd: 14:00

Zaal: Horstring N.109

Summary

Birds and insects have inspired engineers to consider flapping flight as a means of propulsion for small unmanned aerial vehicles. An example of such a Micro Aerial Vehicle (MAV) is the Delfly II. It has four flapping wings made of Mylar that perform harmonic flapping. During the flapping cycle the wings touch each other, which enhances lift. This is known as the Weis-Fogh mechanism. Delfly's design has now reached the stage in which numerical simulation is necessary to enter the next design iteration.

Many conventional techniques for Computational Fluid Dynamics make use of body conforming grids. Generating a body-conforming grid for a complex moving geometry such as the Delfly is a difficult and time-consuming process, often requiring grid modification or interpolation as part of the numerical simulation.

A promising method to circumvent these difficulties is the Immersed Boundary Method (IBM). Instead of using a body conforming grid the method uses a Cartesian grid in the whole computational domain and a separate grid for the surface of the body. The solution on the two grids is coupled through forcing terms introduced in the discretized equations which are active near the surface of the body. This allows the use of fast and efficient solvers.

To test whether IBM methods are a suitable approach to simulate the flow around configurations like Delfly, an IBM has been implemented in two different computational methods: (i) an indirect forcing IBM technique in a LES/DNS method that employs a Cartesian grid, and (ii) a ghost-cell IBM in the open-source flow simulation library OpenFOAM®. As a first step towards numerically simulating flapping flight these methods were verified and validated by comparing their results for two-dimensional low-Reynolds-number flow around a stationary circular cylinder with numerical results from a CFD method employing body-conforming grids as well as numerical and experimental data from literature.

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