Semesterarbeit / Master Thesis / IDP

Institute of Helicopter Technology

CUDA-based Parallelisation of Rotor Aerodynamics Solver

Background:

Rotorcraft industries are constantly striving to improve rotor blade structural and aerodynamic design, while minimizing production costs. For this purpose, prediction tools capable of *comprehensively* analysing rotorcraft performance and loads are being relied upon to provide accurate estimates of structural stresses on rotor blades and other relevant components. The architecture of such modern analysis tools is fairly modular, allowing simulation of even exotic rotorcraft concepts with modeling capability down to the friction between various joints and hinges in the rotor drivetrain. At the heart of such a tool are two most important modules –rotor aerodynamics solver and blade elastic deformation solver – that iteratively solve for the periodic elastic blade motion/deformation given particular operating conditions of the rotorcraft.

Compared to fixed-wing aircraft, the rotational motion of rotor blades complicates their aerodynamics analyses. Presence of more than one rotors in close proximity to each other can additionally lead to mixing of the rotor wakes, further making conventional analysis difficult. A particle-based aerodynamic formulation is attractive for modelling such flows since the discretization scheme is stable while analysing such scenarios. A novel rotor wake aerodynamics solver based on viscous vortex particles formulation is currently being used for analysing a novel rotor geometry at the Institute of Helicopter Technology. The solver is written in C++ and currently uses OpenMP to achieve speed-up. However, this leaves room for improvement since rotor aerodynamics modelling routinely uses vortex particles ~10^6 . From experience, speed-up using traditional 'n-body' algorithms such as Treecode or Fast Multipole method can lead to unphysical results. Therefore, a straightforward implementation of the code, with $O(n^2)$ particle interactions, that is capable of running on the GPU is desired to reduce overall helicopter simulation time.

Goal:

The proposed work would involve implementing a GPU capable formulation of the aforementioned particle solver using CUDA.

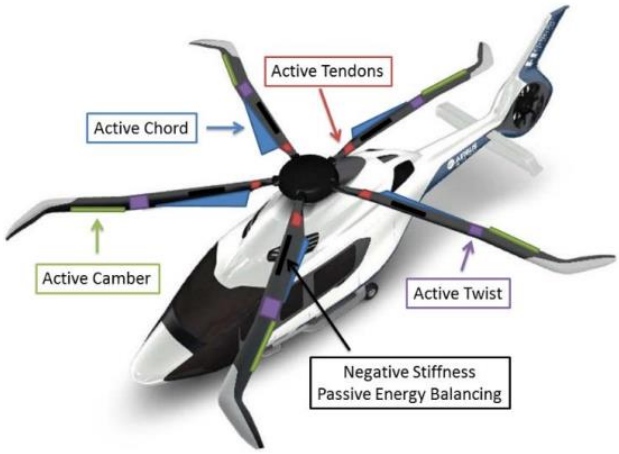
Skills:

No background in rotor physics or aerodynamics required.

Tools: C++/CUDA

Language: English

Start: As soon as possible



Contact:

Sumeet Kumar
Institute of Helicopter Technology
Email: sumeet.kumar@tum.de
Tel: +49 (0)89 / 289-1630