**Mukesh Kumar**

Home country: India
Year of birth: 1983

Ph.D. Degree: Applied Mathematics
University: Indian Institute of Technology Delhi, India
Graduation year: 2009

Research group: Differential Equations and Numerical Analysis
Supervisor: Trond Kvamsdal
Post-doc start: January 2011

Phone: +47-735-90481
Email: Mukesh.Kumar@math.ntnu.no
Home page: http://www.math.ntnu.no/~mukeshk/

**Adaptive methods for accurate CFD-simulations of aerodynamic loads on offshore wind turbines**

The aerodynamic loads on the rotor blades are the largest loads acting on a wind turbine. The horizontal wind turbine types of blades are usually made of two or three airfoils such as a propeller. In these types of blades, it is the lift force which makes the rotor turn. The drag force acts perpendicular to the lift force due to the resistance of the airfoil from the wind and counteracts the rotation to rotor. Therefore, predicting these loads accurately is one of the most important parts of the calculations in wind turbine aerodynamics. Another reason for computing the aerodynamic loads on rotor blades is to model the aeroelastic response of the entire wind turbine construction. There are different methods to calculate the aerodynamic loads on a wind turbine rotor with different level of complexity such as Blade Element Momentum Method (BEM), Vortex Method(VM), and Computational Fluid Dynamics (CFD).

Though CFD has made significant inroads as a research tool, simple, inexpensive methods, such as blade element momentum (BEM) theory, are still the workhorses in wind turbine design and aeroelasticity applications. These methods generally assume a quasi-steady flowfield and use two-dimensional aerodynamic approximations with very limited empirical 3-D corrections. As a result, they are unable to accurately predict rotor loads near the edges of the operating envelope. CFD methods make very few limiting assumptions about the flowfield, and thus have much greater potential for predicting these flows.

Adjoint methods are becoming increasingly important in the CFD analysis of aerodynamic performance. These methods offer reliable estimates of the sensitivity of output functionals, such as lift or drag, to the many parameters involved in numerical simulations. The approach relies on the solution of an adjoint equation and provides error estimates that can be used to both improve the accuracy of the functional and guide a mesh refinement procedure. The aim of the project is to design such reliable error estimates for adaptive methods for accurate CFD-simulation of aerodynamic loads on offshore wind turbines.