**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**
**SHORT ABSTRACT OF THESIS**

| | | |
|---|---|---|
| Name of the Student | : | SIMON PETER |
| Roll Number | : | 09610312 |
| Programme of Study | : | Ph.D. |

Thesis Title: DYNAMICS OF THE WAKE BEHIND AN OSCILLATING AND ROTATING SPHERE IN UNIFORM FLOW

| | | |
|---|---|---|
| Name of Thesis Supervisor(s) | : | DR. ARNAB KUMAR DE |
| Thesis Submitted to the Department/ Center | : | MECHANICAL ENGINEERING |
| Date of completion of Thesis Viva-Voce Exam | : | 30/01/17 |
| Key words for description of Thesis Work | : | VORTEX-INDUCED VIBRATION, FORCED OSCILLATION, ENERGY TRANSFER, WAKE DEFLECTION, IMMERSED BOUNDARY METHOD |

**SHORT ABSTRACT**

The primary objective of the current research is to reveal the wake dynamics of a simultaneously oscillating and rotating sphere in uniform incompressible flow. To achieve these objectives, an in-house code incorporating: Finite volume method, non-staggered arrangement of variables, non-uniform cartesian grid, non-inertial frame of reference, distributed memory allocation parallelization, ghost-cell immersed boundary method (GCIBM), SIP preconditioned BiCGSTAB linear solver is employed.

The parameters employed for only oscillating sphere in uniform flow are: Reynolds number (Re=300), normalized oscillation amplitude (A=0.5) along the transverse direction and frequency ratio ($0.16 \leq f_R \leq 1.3$). Effects of simultaneous rotation on an oscillating sphere are considered at normalized angular velocity ($\alpha$=1.2) along the three primary directions (x, y, z) at $f_R$=1.3 and 0.8. Time signals of the force coefficients their frequency spectra, instantaneous vorticity and wake structure are analysed to reveal the underlying physics. Following may be considered as the contributions: 1) enhancing the capabilities of a previously reported GCIBM, 2) revealing two forcing mechanisms with their impact on energy transfer for forced oscillation of a structure in uniform flow, 3) finding similarity between the wake modes for forced and free oscillation of a sphere in uniform flow, 4) observing different flow features for simultaneous oscillation and rotation of a sphere.