	INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI **PhD-17 SHORT ABSTRACT OF THESIS**

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Thesis Title: DEVELOPMENT OF A THREE-COMPONENT STRESS WAVE BALANCE AND SOFT-COMPUTING RECOVERY TECHNIQUES FOR PREDICTION OF AERODYNAMIC FORCES		
Name of Thesis Supervisor(s)	:	**Prof. Niranjan Sahoo and Prof. Vinayak Kulkarni**
Thesis Submitted to the Academic Division	:	**Mechanical Engineering**
Date of completion of Thesis Viva-Voce Exam	**:21/01/2026**	**10:00 AM**
Key words for description of Thesis Work	:	**Hypersonic Flow, Shock Tunnel Testing, Force Measurement, Soft Computing Recovery Techniques, Aerodynamic Coefficients.**

SHORT ABSTRACT

Accurate force measurement is essential in the design and performance evaluation of hypersonic vehicles, as it directly influences stability assessment and fuel requirement estimation. This research focuses on the development and utilization of an impulsive test facility in the form of a shock tube to study the aerodynamic behaviour of test models under simulated high-speed flow conditions. The shock tube was carefully designed and fabricated with due consideration to safety aspects associated with high-pressure operation and was thoroughly calibrated prior to experimentation. Experiments were conducted using a hemispherical test model integrated with a stiffness-based force balance. Dynamic strain generated during testing was measured using piezofilm sensors mounted on the balance. Aerodynamic forces were initially recovered using established force recovery techniques such as de-convolution and Adaptive Neuro-Fuzzy Inference System (ANFIS), and the results showed good agreement with calibration and shock test data. To enhance force prediction accuracy, a new soft-computing-based recovery technique using a Genetic Algorithm (GA) was developed. The GA was first applied to predict drag force using shock tube experiments conducted at 0° angle of attack. Dynamic calibration with a single-point calibration method was employed to train the algorithm. The GA-based drag predictions were compared with Support Vector Regression (SVR) and de-convolution methods, demonstrating comparable accuracy. The robustness of the GA was further validated by testing configurations with and without a spike ahead of the model. Subsequently, the GA approach was extended to predict three aerodynamic coefficients—lift (Cl), drag (Cd), and pitching moment (Cm). Shock tunnel experiments were performed at 10° angle of attack, and the predicted coefficients were compared with ANFIS and empirical methods. The results indicate that the GA-based technique provides reliable and accurate force predictions, making it a promising tool for aerodynamic force measurement in hypersonic testing.