The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

PROJECT TITLE	**ADVANCED OPTIMAL ROBUST CONTROL METHODOLOGY FOR SPACECRAFT SYSTEMS**
PROJECT CODE	**UQIDAR 00217**
PROJECT DESCRIPTION	This work proposes the design of an optimal sliding mode control (SMC) for a nonlinear & coupled dynamics of spacecraft based on the Legendre pseudospectral method (PSM). In recent times, PSM, a numerical optimal control method, has become popular owing to its fast convergence and ease in handling of constraints, particularly in space applications. The pseudospectral method has been shown in the state of the art to perform well in solving a wide range of optimal control problems with varied performance indexes, stringent endpoint conditions along with path constraints. These advantages make the use of Legendre PSM based sliding mode controller a good choice for an Optimal-Robust controller. By the use of the proposed methodology, the objective function can be optimized, while satisfying the constraints on state & controls, which would be difficult using only SMC. The gains of the robust controller can further be tuned adaptively by involving adaptive control concepts to overcome the problem of overestimation and underestimation. The stability analysis of the proposed PSM based adaptive-robust scheme can be investigated through Lyanpunov stability analysis. Numerical simulations will be included to demonstrate the effectiveness of the proposed method. Spacecraft and other non-linear systems which has various applications in technologies of the future, can be considered for demonstrating the optimal-robust performance of the proposed strategy. On application of the proposed controller, the time-energy efficient performance of the spacecraft can be demonstrated while tackling external disturbances and uncertainties that it encounters.
PROJECT OUTCOMES	A PhD level work comprising of 1) Literature survey and Conceptualization of the method 2) Implementation of the method 3) Application of the proposed methodology to the spacecraft problem 4) Stability analysis and result verification with simulations
ADVISORY TEAM	**Dr Erkan Kayacan** Mechanical and Mining Engineering www.erkank.net **Associate Professor Mashuq un Nabi** Electrical Engineering http://ee.iitd.ac.in/people/mnabi.html **Additional advisors** Assistant Professor Subashish Datta
TYPE OF STUDENT	Applications are open to **i-student**s who meet eligibility criteria.
DISCIPLINE BACKGROUND OF STUDENT	Ideally, this project requires students with a background in: Bachelors : Control, Electrical or Mechanical Engg. Masters : Control Theory or Engineering

IDEAL CANDIDATE	Essential capabilities: 1. Good score in Bachelors (First class) 2. Must have passed Mathematics courses covered in Undergraduate with at least B grade. Desirable capabilities: 1. Sound knowledge of matrix theory & linear algebra 2. Understanding of Linear Systems & stability of Nonlinear Systems Expected qualifications (courses, degrees, etc): Bachelors : Control, Electrical or Mechanical Engg. Masters : Control Theory or Engineering
APPLICATION PROCESS	Apply online by the due date: https://www.uqidar.org/students/how-to-apply/