AEROSPACE & MECHANICAL ENGINEERING

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INFORMAL COFFEE PERIOD BEFORE THE SEMINAR IN ROOM 365 FITZPATRICK HALL

UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Gwen Johnson**
Department of Aerospace Engineering
California Institute of Technology
Pasadena, California

TOPIC: NON-SMOOTH CONTACT AND CONTROL FOR SELF-ASSEMBLING (SPACE) SYSTEMS

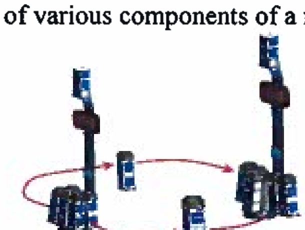
DATE: Thursday, April 19, 2012

TIME: 10:30 am

PLACE: 246 DeBartolo Hall

ABSTRACT

A self-assembling system is a system in which a collection of bodies (e.g., cells, particles, robots) arrange themselves into a larger coherent structure which is typically endowed with different or augmented functionality. The concept of a self-assembling space telescope built with nano satellite components represents a paradigm shift in large aperture design and construction because at present, the size of space apertures is limited by--among other factors--what can be creatively folded into the payload of a rocket. Motivated by the idea that bigger is always better, a collaborative technical development grant from the Keck Institute for Space Studies (KISS) aims to demonstrate the feasibility and practicality of various components of a modular telescope system (see Figure1).



{Figure 1: Concept for a reconfigurable space telescope.}

The problem of accurately and robustly modeling the dynamics of a self-assembling system presents several challenges. The dynamics to be modelled include collisions, sustained contact (i.e. clumping or jamming), and complicated multiple-contact scenarios in stiff systems. A general model also needs to account for non-smooth non-convex bodies and strong attractive forces at contact interfaces between bodies. In addition to solving the contact problem in forward dynamics, control algorithms for self-assembling systems must also treat the problems of non-smooth collision avoidance and planned collisions.

This talk will include a discussion of a robust subdifferentiable fine-scale collision detection algorithm for non-smooth bodies, which has additional features that directly enable the use of inelastic and frictional contact models (e.g., the algorithm also results in a full description of the contact surface). The formulation of optimal control problems with non-smooth collision avoidance and planned collisions will also be discussed. Several examples of passive self-assembly, docking, and reorientation maneuvers will be considered