Short Course for ACC 2009

1) Course Title : ***Tensegrity Systems***

2) Course Duration: (two days)

3) Intended audience

This course is designed for engineers and managers who are involved in shape-controllable structure design, reaching such applications as aircraft wings, deployable space structures, robotics, earthquake resistant civil structures, and formation flying problems.

4) Course Text (not included)

{TENSEGRITY SYSTEMS, Skelton and de Oliveira, by Springer Verlag 2009, 250 pages, **ISBN**: 9780387742410}

websites:
http://www.borders.co.uk/book/tensegrity-systems/792249/
http://www.amazon.com/Tensegrity-Systems-Robert-E-Skelton/dp/0387742417/ref=sr_1_1?ie=UTF8&s=books&qid=1236969551&sr=1-1
http://search.barnesandnoble.com/Tensegrity-Systems/Robert-E-Skelton/e/9780387742410

5) Instructors

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4) Course Description

The purpose of this course is to provide some analytical machinery that can be useful to integrate structure and control design. A critical focus is to determine the optimal complexity of the minimal mass structure, and to show that the optimized structure usually has a finite complexity. The first challenge is to choose the right paradigm for structure design. A tensegrity paradigm for structures (an assembly of "sticks" and "strings") will allow one to modify the equilibrium of the structure to achieve the new desired shape, so that power is not required to hold the new shape. Such cooperation between the static and dynamic properties of the structure and the control system can only be accomplished by a structure design paradigm that maintains an extremely high degree of "controllability" during all phases of the structure design. This requires new types of structures and the tensegrity structural paradigm is the only one the authors have found with these properties.

(4.1) key topics of the course:
The tensegrity paradigm
Optimal structures for bending loads
Optimal structures for compressive loads
Deployable wing design
Deployable cantilevered beam
Nonlinear control of tensegrity systems

(4.2) Outline, Day 1
The tensegrity paradigm
- Biological systems which are tensegrity
- Class 1, class 2, and class k tensegrity systems
- Tensegrity prisms

Minimal Mass Structures for Bending loads
- The Michell Topology
- Linear force propagation
- The optimal tensegrity structure for bending
- The optimal complexity of bending structures
- Deployable cantilevered beam

Minimal Mass Structures for compressive loads
- The T-Bar system
- The self-similar T-Bar iterations for compressive loads
- Optimal complexity of compressively loaded T-Bar tensegrity structures
- The D-Bar system
- The self-similar D-Bar iterations for compressive loads
- Optimal complexity of compressively loaded D-Bar tensegrity structures
- Deployable wing using a combination of T-Bar and D-Bar designs
- Towers, minimal mass and optimal complexity
- Plates, minimal mass and optimal complexity

(4.3) Outline, Day 2
Dynamics for class 1 tensegrity systems
- vector forms
- matrix forms
- adding constraints

Statics for tensegrity systems