POLITECNICO DI TORINO

DISEG
Department of Structural, Geotechnical and Building Engineering

# AVVISO DI SEMINARIO DI DIPARTIMENTO

Structural Optimization, Form-finding and Bioinspired Design

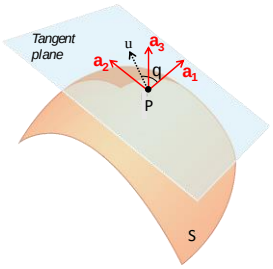
**17 Febbraio 2020**
**Dipartimento DISEG**
Ingr. 1 p.2
**Aula Albenga** – 14:30 - 16:30

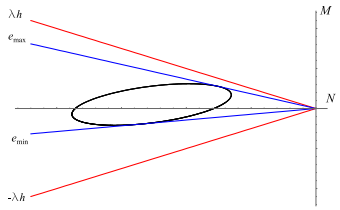
In vista ed in preparazione del 1st IWSS - Italian Workshop on Shells and Spatial Structures https://sites.google.com/view/iwss2020/home

Tali contributi rappresentano un interessante "stato dell'arte" dell'attuale ricerca italiana nell'ambito della progettazione delle strutture leggere, dei gusci e delle coperture di grande luce.

## A Relaxed Definition of Funicularity for Shell Structures

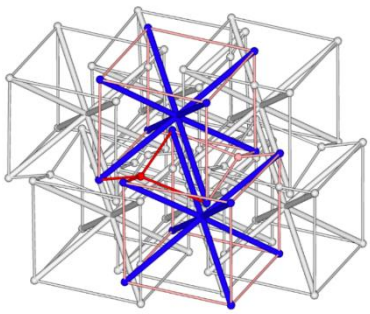
Prof. Stefano Gabriele – Università Roma Tre



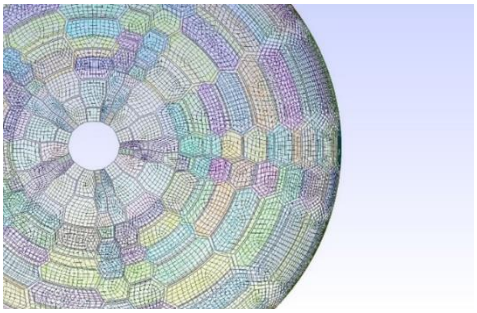

## Form-Finding, Analysis, and Design of Tensegrity Systems - Recent Studies

Prof. Andrea Micheletti – Roma Tor Vergata



## Bioinspired Design of Shell Structures: a Lesson from Echinoids

Prof. Francesco Marmo – Federico II Napoli



Amedeo Manuello Bertetto Ph.D.
Assistant ProfessorDept. of Structural Geotechnical and Building Engineering Politecnico di Torino

## A Relaxed Definition of Funicularity for Shell Structures
Prof. Stefano Gabriele - Università Roma Tre

Funicularity is well defined concept for structures that could be modelled by means of 1D elements, the same definition can't be coherently applied to 2D shell structures. This is due to the internal statical indeterminacy of a shell model. On the other side it is possible to design optimized shell structures, where optimized means that the shell behaves in a prevalent membrane state of equilibrium with respect to the flexural one. As an example, one could refers to the form finding methods, where a general assumption is the nullity for the flexural contribution. In actual shells this contribution could be minimum but almost never zero. For this reason, has been considered worth to redefine the funicularity for shell structures in a relaxed way, named Relaxed Funicularity or R-Funicularity.
During the seminar the R-Funicularity definition will be presented together with it's nice graphical representation, that is related to the Mohr's circles of both the tensors of the internal membrane forces and the moments. Some applications of the R-Funicularity are finally presented and discussed.

## Form-Finding, Analysis, and Design of Tensegrity Systems - Recent Studies
Prof. Andrea Micheletti - Roma Tor Vergata

In the last years, there has been an ever-increasing number of studies on tensegrity structures in different engineering fields, owing mainly to their highly nonlinear behavior, which makes them attractive in several applications.
After a summary of the basic notions and principles underlying their mechanical behavior, some recent studies will be described, including: the design of an in-orbit deployable reflector, the propagation of solitary waves in modular assemblies, and the form-finding of nested endoskeletal systems.

## Bioinspired Design of Shell Structures: a Lesson from Echinoids
Prof. Francesco Marmo - Federico II, Napoli

Echinoids are a class of marine organisms that includes sea urchins and sand dollars. They underwent an incredible adaptive radiation, and specialized in variable forms and life styles to live in different marine environments. In particular, the geometry and structure of their calcitic test has evolved to efficiently withstand biotic and abiotic actions. Such an optimization process, conducted by natural selection and evolution, serves as an inspiration for designing light and efficient shell structures capable to bear a large variety of loading conditions mainly by membrane actions and limited bending stresses. We examine the feasibility of developing a bio-inspired design process that combines classical form-finding algorithms with the introduction of flexible connections inspired by those developed by echinoids to reduce bending actions within their endoskeletons.