Unione Europea

Ministero dell'Istruzione, dell'Università e della Ricerca

Università degli Studi di Salerno

DIPARTIMENTO DI INGEGNERIA CIVILE

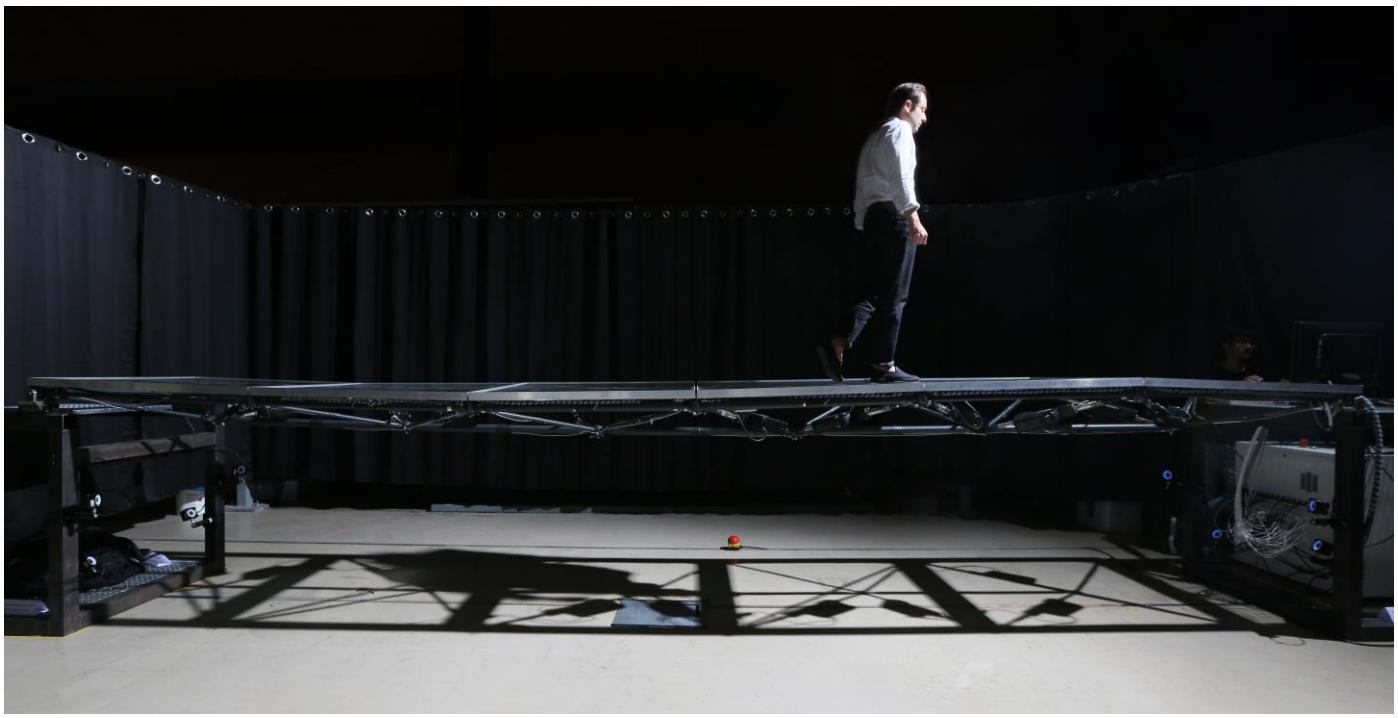
Dottorato di Ricerca in *Rischio e Sostenibilita' nei Sistemi dell'ingegneria Civile, Edile E Ambientale*

08 Novembre 2019, ore **09:15-10:45,** Sala Multimediale Laboratorio Strutture Strength L2

Dr Gennaro Senatore

Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland

Design and control of adaptive civil structures



Adaptive structure prototype, Applied Computing and Mechanics Laboratory (IMAC), EPFL

Designing structures with minimal environmental impact is now a serious concern in the construction sector. Active control has been used in civil engineering for a variety of purposes. The most widespread application so far has been in vibration control. The potential of using adaptation to save material mass has been investigated by some but whether the energy saved by using less material makes up the energy consumed through control and actuation is a question that has so far received little attention.

Dr Senatore formulated a new method to design minimum energy adaptive structures. This design method synthesizes structural configurations that are optimum hybrids between a passive and a fully active structure to minimize the structure whole-life energy comprising an embodied part in the material and an operational part for adaptation to loading. Structural adaptation through sensing and actuation is employed to counteract the effects of large loading events through control of the internal load-path and the structure geometry. Extensive numerical simulations, which compare adaptive solutions with weight-optimized passive structures, has shown that the whole-life total energy could be reduced by up to 70% for slender structures. Structures produced by this method can also fulfil other functions such as being extremely slender and being capable of reducing deflections completely thus achieving an effective “infinite” stiffness at specific points. Being able to combine these three objectives is unique in structural engineering: (1) the structure has a low overall environmental impact (minimum energy design); (2) the structure can be extremely slender and (3) at the same time displacements can be controlled within very tight limits (i.e. extremely stiff). Adaptive structures can meet much stricter deflection limits at the expense of a small amount of operational energy which gives several benefits including: increased slenderness for tall buildings, bridge and self-supporting roof-systems; increased building floor area via reduction of structural cores; improved comfort in buildings that experience large displacements (for example, high-rise buildings).

A large-scale prototype has been successfully tested validating key assumptions and numerical predictions. This prototype was exhibited at various key institutions among with University College London, International Association for Shell and Spatial Structures (IASS), a well-known gallery space called “The Building Centre” situated in central London and since 2018 it has been in permanent exhibition at the Institute of Lightweight Structures and Conceptual Design (ILEK) at University of Stuttgart.

Further information: *www.gennarosenatore.com*