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DICCA COLLOQUIA

Tues Nov 19th 2024, 4pm, salone nobile DICCA
Via Montallegro 1, villa Cambiaso
Followed by reception in the loggiato

John Hutchinson

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Shell Buckling in 2024.

The stability of structures continues to be scientifically fascinating and technically important. Shell buckling emerged as one of the most challenging nonlinear problems in mechanics sixty years ago when it was intensively studied. The subject has returned to life motivated not only by structural applications but also by developments in the life sciences concerning soft materials. Efforts are underway in the US, China and Europe to update existing design codes for shell buckling to take account of computational and experimental advances which promise to enable less conservatively designed structures. The challenge is that shell structures are susceptible to catastrophic collapse and dramatic load-carrying reductions due to relatively small imperfections in their geometry. Imperfections must be factored into buckling load estimations. Most modern aerospace shells are either metallic reinforced with stiffeners or fiber reinforced composites, both manufactured to high levels of precision. This precision and the relatively recent theoretical developments that have emerged relevant to the distinction between realistic local imperfections versus less realistic global imperfections has made it possible to design shell structures that are substantially lighter than those the design existing codes from 60 years ago would allow. These developments will be highlighted in the seminar, complimented by a presentation of current experimental and theoretical work underway by the author and his collaborators on the imperfection-sensitivity of stiffened shell structures. Every attempt will be made to make the subject assessable and interesting to a broad engineering science audience.

John W. Hutchinson, Abbott and James Lawrence Professor of Engineering and Gordon McKay Professor of Applied Mechanics Emeritus, has been elected to foreign membership in the Royal Society. He was among eight foreign members and 44 new fellows welcomed by the United Kingdom's elite national academy. Hutchinson is a seminal scholar in the field of solid mechanics and materials engineering, and is more highly cited than any other researcher in this area. He studied engineering mechanics as an undergraduate at Lehigh University. After earning his Ph.D. in mechanical engineering at Harvard in 1963, he spent a year in Denmark before returning to join the Harvard faculty, where he very soon made dramatic contributions to the study of buckling in elastic structures. Over a 50-year career at Harvard, he has been one of the major developers of nonlinear fracture mechanics. He has made groundbreaking contributions in micromechanics, including the plasticity of polycrystals, cracking of fiber-reinforced ceramics, and delamination of thermal barrier coatings (TBCs). For example, ceramic TBCs are widely used in aircraft and power generation turbines to shield the engine blades and other metal components from high temperatures. However, the use of TBCs contributes to an industry trend toward engines that operate at even higher temperatures, threatening the durability of the coatings. Concern for plastic deformation at the scale of microns led to his publications in strain-gradient plasticity, which have sparked a world-wide explosion in related research.