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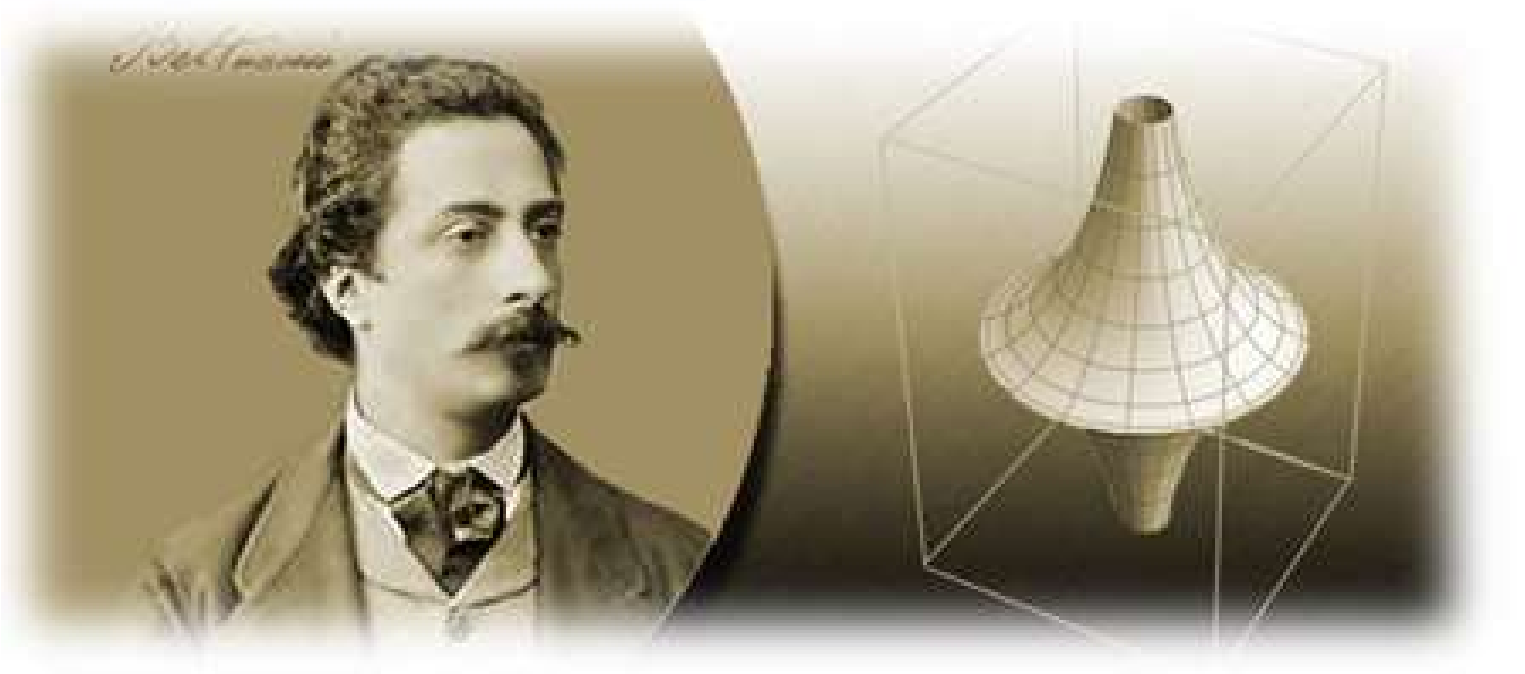

EUGENIO BELTRAMI INTERNATIONAL PRIZE 2023

LAUDATIO FOR PROF. GIOVANNI SEMINARA

MEMOCS CENTER

Giovanni Seminara is currently Professor Emeritus at the University of Genova (Italy), where he held the chair of Fluid Mechanics from 1986 to 2015.

His higher education started at the University of Genoa, where he graduated in Civil Engineering in 1969. After a brief period (1969-1973) spent at the Institute of Hydraulics as Assistant Professor, he moved to the University of London (Imperial College) where he received his postgraduate education in Applied Mathematics. In 1976, he was awarded a PhD discussing a dissertation on 'The stability of some unsteady viscous flows'.

Throughout his career, Seminara has constantly sought novel research paths to refresh a research field that, at the time (the 70's of the last century) was still mostly motivated by its important applications in water engineering. They involved high Reynolds number turbulent flows (in pipes or open channels), effectively inviscid flows (e. g. water waves) or flows in porous media. Closures for the classical de Saint-Venant equations were still based on empirical relationships developed in the XIX century, ignoring developments in turbulent research which was experiencing significant progress in the parallel field of Aerodynamics.

In order to deepen his understanding of basic fluid mechanics, Seminara decided to explore the nascent field of bio-fluid mechanics, a pioneering enterprise, as the years to come would demonstrate. Indeed, physiological flows, notably blood flow in the circulatory system, exhibits a number of challenging features: in particular, the flow is either laminar or at most transitional, boundaries are not rigid, as vessels are either elastic or weakly viscoelastic.

At the time, the Department of Aeronautics of Imperial College in London was a pioneer Institution as it contained a research group (the Physiological Flow Studies Unit, PFSU) where a unique, interdisciplinary environment, had been created attracting experts in fluid mechanics, applied mathematicians, chemical engineers, clinicians and even surgeons. There, Seminara engaged himself in the effort to provide some fluid mechanics support to Caro's theory on the origin of atheroma. The latter was motivated by the observation that fatty streaks are preferentially observed in specific sites of the arterial network, notably arterial bifurcations and the inner aortic arch. He ended up investigating theoretically and experimentally the centrifugal instability of a Stokes layer, the prototype of viscous oscillatory boundary layers, a yet unexplored subject. The observed and predicted formation of Taylor vortices was the first significant achievement in the nascent field of hydrodynamic stability of unsteady viscous incompressible flows.

Back at the University of Genoa, Seminara's involvement in bio-fluid dynamics decreased (though it has been recently revived to assess the possible role of airborne transmission of the COVID19 infection). On the contrary, his interest for hydrodynamic stability was enhanced in cooperation with foreign colleagues and members of his nascent school. Most notable are his extension of Rayleigh's criterion to unsteady flows (JFM, 1979), the analysis of transition in the Stokes layer at the bottom of water waves (Rend. Acc. Lincei, 1979), the stability of growing-collapsing bubbles (Physics of Fluids, 1978), the nonlinear oscillations of non-spherical cavitation bubbles in acoustic

fields (JFM, 1980), the occurrence of chaos as a result of mode competition in the shape oscillations of pulsating bubbles (JFM, 1995).
In the '90s the MoSE gate system for the protection of Venice from high waters was being designed. Experimental verification of the design configuration pointed out the possible occurrence of an unexpected phenomenon of asynchronous oscillation of the gates which would reduce the efficiency of protection. In a series of papers (Rend. Acc. Lincei, 1993 a,b; Proc. Roy. Soc., 1996) the mechanical origin of the observed phenomenon was clearly identified by Seminara and coworkers.
In the early '80s Seminara was also attracted by the variety of phenomena arising in natural water bodies, due to the erodible (hence mobile) character of the interface between the water body and its boundary. The latter is hardly in equilibrium and typically evolves, leading to the formation of an astonishing variety of natural patterns (meandering, braiding, hillslope patterns, alluvial fans, deltas, submarine turbidity currents, etc). Investigating these processes required a new challenging shift of paradigm. Seminara devoted the second season of his research activity to progressively building up a rational theory of morphodynamics, a new discipline that has grown to become an independent branch of geophysics. Some of Seminara's main achievements are collected in two review papers. The former, focusing on meandering (JFM, 2006), was invited as one of the topical contributions to the special issue for the 50th anniversary of the Journal of Fluid mechanics. The latter was published in 2010 as an invited contribution to the Annual Review of Fluid Mechanics. Theoretical Morphodynamics is also the subject of three monographs recently completed by Seminara and some of his coworkers (Blondeaux et al, 2018; Seminara et al, 2023a, b).
More recently, the need for a further change of paradigm emerged. Indeed, ignoring the role of biota, morphodynamics is unable to interpret a bunch of important processes arising from the interaction of water bodies with vegetation. A major area where such need is strongly felt is that of coastal wetlands, environments rich in biodiversity of great ecological value. Their very existence is threatened nowadays in many parts of the world for a variety of reasons, notably sea level rise and artificial subsidence. Of special interest the degradation undergone by the salt marshes of Venice lagoon in the last two centuries. Seminara devoted the third season of his research career to the understanding of sediment transport in tidally dominated coastal environments. These efforts showed that the survival of coastal wetlands depends on a delicate balance between supply of inorganic sediments, production of organic sediments by the life cycle of vegetation, sea level rise and subsidence. A recent state of the art review on the subject (Rend. Acc. Lincei, 2022) summarizes the achievements of Seminara and coworkers in this field, which was described as the 'intrusion' of Ecology into Fluid Mechanics.

In recognition of the above research achievements, Seminara has been coopted by various Academies: Fellow of Accademia dei Lincei since 2001, nonresident Fellow of Istituto Veneto di Scienze, Lettere ed Arti since 2004, Fellow of Accademia Ligure di Scienze e Lettere since 2000. He has chaired the Lincei Environmental Committee from 2019 to 2022 and represented Accademia dei Lincei in the InterAcademy Panel IAP, and various G7 Science Committees (Washington, 2012; Tokio, 2016; Rome, 2017; Ottawa, 2018).
He also accepted academic and technical responsibilities. At the local level, he was elected Head of the Department of Civil & Environmental Engineering and Member of the Academic Senate. At the

national level he was nominated expert member of the Technical Committee of Magistrato per il Po, the Agency for the management of the largest Italian fluvial basin. He was also coopted in the Scientific Committee of CoRILA (a state agency coordinating the research activities concerning the Venice lagoon) and in the Commissione Grandi Rischi (the Italian committee in charge of advising the Civil Protection Agency on the actions required to protect citizens from great hazards).
At the international level, Seminara represented the Italian scientific community in the European Mechanics Council, a European body promoting the organization of meetings of small scale (Colloquia) and large scale (Conferences) in all fields of Mechanics. He chaired the Euromech Colloquium 215 on ``Sediment transport in River and Coastal Environments'' (S. Margherita Ligure, 1987), and was member of the Scientific Committee of the 1st European Conference of Fluid Mechanics (Cambridge, 1991) and the 2nd one held in Warsaw (1994). Later, he was coopted in the Advisory Board of the European Mechanics Society.

Seminara devoted much effort to the education, training and supervision of more than a generation of young students and scientists. Seventeen of his former PhD students are now accomplished Professors in various national and international universities (Genoa, Padua, Trent, Florence, Minnesota, Hong Kong). He acted as external examiner for PhD dissertations in various European Universities (Utrecht, Grenoble, Bristol). He also promoted the dissemination of recent research achievements among the young generations organizing successful Summer Schools (Perugia (Italy), 1990; Nobihiro (Japan), 1992) that eventually evolved into the establishment of a series of biennial Symposia on River, Coastal and Estuarine Morphodynamics (RCEM), the first of which was held in Genoa (Italy) in 1999.
Between 1995 and 1999, he joined the Editorial Board of the International Journal MECCANICA, as Associate Editor and more recently he was nominated Section Editor of Rendiconti Lincei, Scienze Fisiche e Naturali.

For the great, original, innovative value of all his activity, which perfectly matches the award criteria requiring “Transversal capacities to reach multidisciplinary fields”, for his entire career, almost half a century, seeking a dialogue among different disciplines, for his unique sense of sustainability and deep respect for earth and living species, the Scientific Committee of the International Research Center MeMoCS, responsible for awarding the International Eugenio Beltrami Prize, unanimously proposes Professor Giovanni Seminara as the recipient of the 2023 edition.