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Understanding turbulence-chemistry interaction of zero-carbon fuels for fuel-flexible power generation and propulsion applications

Professor Andrea Gruber

SINTEF Energy Research / NTNU

Date： Wednesday, November 22, 2023 13:00-14:30

Venue： Faculty of Engineering Bldg. 2, Room 232

Abstract:
Modern gas-turbine technology has evolved based on the abundance of hydrocarbon fossil fuels playing a crucial and unreplaceable role in aviation, due to their high-power density, and in the stabilization of the electric grid, due to their fast response and sizeable on-demand output. Although fuel-flexible in principle, gas turbines can encounter serious operational issues related to flame stability and emissions because of the vastly different combustion properties of relevant carbon-free fuels, as hydrogen and ammonia, compared with conventional hydrocarbon fossil fuels. Hydrogen is highly diffusive, extremely reactive, and its turbulent burning rate exhibits a strong pressure dependence yet to be fully explained. Ammonia is a convenient hydrogen carrier that can be partially, or fully, decomposed to hydrogen but requires careful emissions control. This lecture provides an overview of modern gas turbine technology and, based on fundamental insights provided by first-principles direct numerical simulations and experimental evidence, introduces the main combustion-related challenges preventing the adoption of carbon-free fuels in gas turbines and proposes potential solutions.

Professor Andrea Gruber
SINTEF Energy Research / NTNU

Biography:
Andrea Gruber holds a doctoral degree in Mechanical Engineering from NTNU (2006), he is Senior Research Scientist at SINTEF Energy Research and Adjunct Professor at NTNU. His research interests are in the development and application of massively parallel direct numerical simulations (DNS), a high-fidelity numerical approach to accurately predict turbulent reactive flows, to problems of practical relevance. Pursuing the improvement of industrial applications within the framework of numerous national and European initiatives (BIGH2, NCCS, DiHI-Tech, ENCAP, DECARBit, FLEX4H2, HyPowerGT) and in close partnership with the gas turbine industry (ALSTOM, Ansaldo Energia, Siemens Energy, Thomassen Energy), he has contributed to the fundamental understanding of key turbulence-chemistry interaction processes that play a major role in the achievement of clean and efficient power generation.

主催：　東京大学大学院工学系研究科専攻間横断型教育プログラム 機械システム・イノベーション（GMSI）
未来社会協創国際卓越大学院（WINGS CFS）
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工学系WINGS産学協創教育推進基金
本件連絡先：　東京大学大学院工学系研究科機械工学専攻　講師　李　敏赫
GMSI事務局　E-mail: office@gmsi.t.u-tokyo.ac.jp　Phone:　03-5841-0696