WORKSHOP

ADVANCES IN DETONATION BASED ENGINES RELEVANT UNSTEADY TURBOMACHINERY FLOWS

Tuesday, November 26th, 2019 | Aerospace Faculty Library | 08:00-17:30

08:00 - Registration and Introduction

8:30 - Prof. Guillermo Paniagua

- Detonation based cycles, difference between detonation and deflagration
- Types of pressure gain combustion concepts
- Rotating detonation based cycles for different applications:
  - Single shaft, turbojet
  - Power delivered to a shaft, turbo-shaft

9:15 - Dr. Bayindir Saracoğlu

- High-fidelity modeling of constant volume combustion
  - Numerical modeling of detonation combustors with finite-rate chemistry
  - Governing equations, flux calculations and limiters

9:45

10:00 - Dr. Bayindir Saracoğlu

- High-fidelity modeling of constant volume combustion
  - Conjugate heat-transfer modeling of detonation engines
    - Treatment of fluid-solid interface
    - Long duration operation of RDE
  - Effect of detonation waves on the compressor flows
    - Numerical simulations on the radial compressors subjected to periodic pressure fluctuations
- Interaction of detonation waves with downstream components
  - Wave propagation through the nozzle guide vanes
- Alternative considerations: Magneto-hydrodynamic (MHD) power extraction from detonation combustors
  - Principles of MHD power extraction
  - Governing equations and test setup
  - Benefits and limitation of MHD power extraction from detonation engines

11:40 - Prof. Guillermo Paniagua

- Experimental work on detonation

12:00

12:45 - Prof. Guillermo Paniagua

- Design, performance and optimization of supersonic axial turbines
- How to retrofit existing gas turbines with rotating detonation combustors
- Development of radial outflow turbines
- Alternative turbine designs, such as bladeless turbines
- Preliminary testing of the detonation with a turbine

14:00 - Dr. John Clark

- High lift / High work low pressure turbine design and the impact of unsteadiness
  Part I - Turbine Aerodynamic Design Process
  - Iterative design loop: an example for a multi-stage, low pressure turbine
  - Meanline design to meet cycle requirements
  - 2D profile design
  - 3D stacking and steady Navier-Stokes analysis
  - Unsteady Navier-Stokes analysis

15:00

15:15 - Dr. John Clark

- High lift / High work low pressure turbine design and the impact of unsteadiness
  Part II - Important Flow Physics and Modeling
  - General observations: The Reynolds Lapse
  - Boundary-layer transition
  - Boundary-layer separation
  - Secondary flow
  - Unsteady interactions

16:20

16:30 - Dr. John Clark

- High lift / High work low pressure turbine design and the impact of unsteadiness
  Part III - Design Studies and Validation Experiments
  - Cascades:
    - L-series airfoils
    - Design for secondary flow management
    - Passive flow control
    - Compressible flows
  - Stages:
    - ND-HiLT01
    - Further design improvements