



## ÉCOULEMENTS INSTATIONNAIRES EN TURBOMACHINE

### UNSTEADY FLOW IN TURBOMACHINE

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| Lecturers : 24.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 4.0 | Project : 0.0 | Language : AN

#### Objectives

Exchanges between the fluid and the structure are involved in turbomachinery either to extract energy from the fluid (turbines), or to transfer energy to the fluid (compressors). While these energy levels may be very large, one part may be diverted to feed unsteady mechanisms, leading some time to the machine blowout. The course objective is to study some of these unsteady mechanisms and to answer basic questions : why and how are they generated, how do they grow, is it possible to control them or to delay their onset, is it possible to simulate them numerically or to measure them experimentally ?

**Keywords :** turbomachinery, unsteady flows, aeroelasticity, instabilities, coupled phenomena

#### Programme

1. Out-of-design performances degradation : operability reduction due to cumulative effects in multi-rows machines; quasi-steady or fully unsteady phenomena
2. Rotor-stator interactions : potential effects in subsonic and supersonic regimes; wakes behaviour through turbines and compressors channels; forced vibration of the structure
3. Aerodynamic instabilities : description, analysis and model of surge; rotating stall; example of recent research in multi-stages axial compressors
4. Fluid-structure coupling and aeroelasticity instabilities : history of failures related to flutter; specificities of flutter in turbomachinery

#### Learning outcomes

- To name the main unsteady phenomena in turbomachinery
- To formulate interaction scenarios between these phenomena
- To evaluate the characteristic frequencies of these phenomena
- To split in basic physical phenomena the complex behaviour of a turbomachine from data based on simulations or measurements

#### Independent study

Objectifs :

Méthodes :

#### Core texts

#### Assessment

Final mark = 100% Knowledge  
Knowledge = 100% final exam