



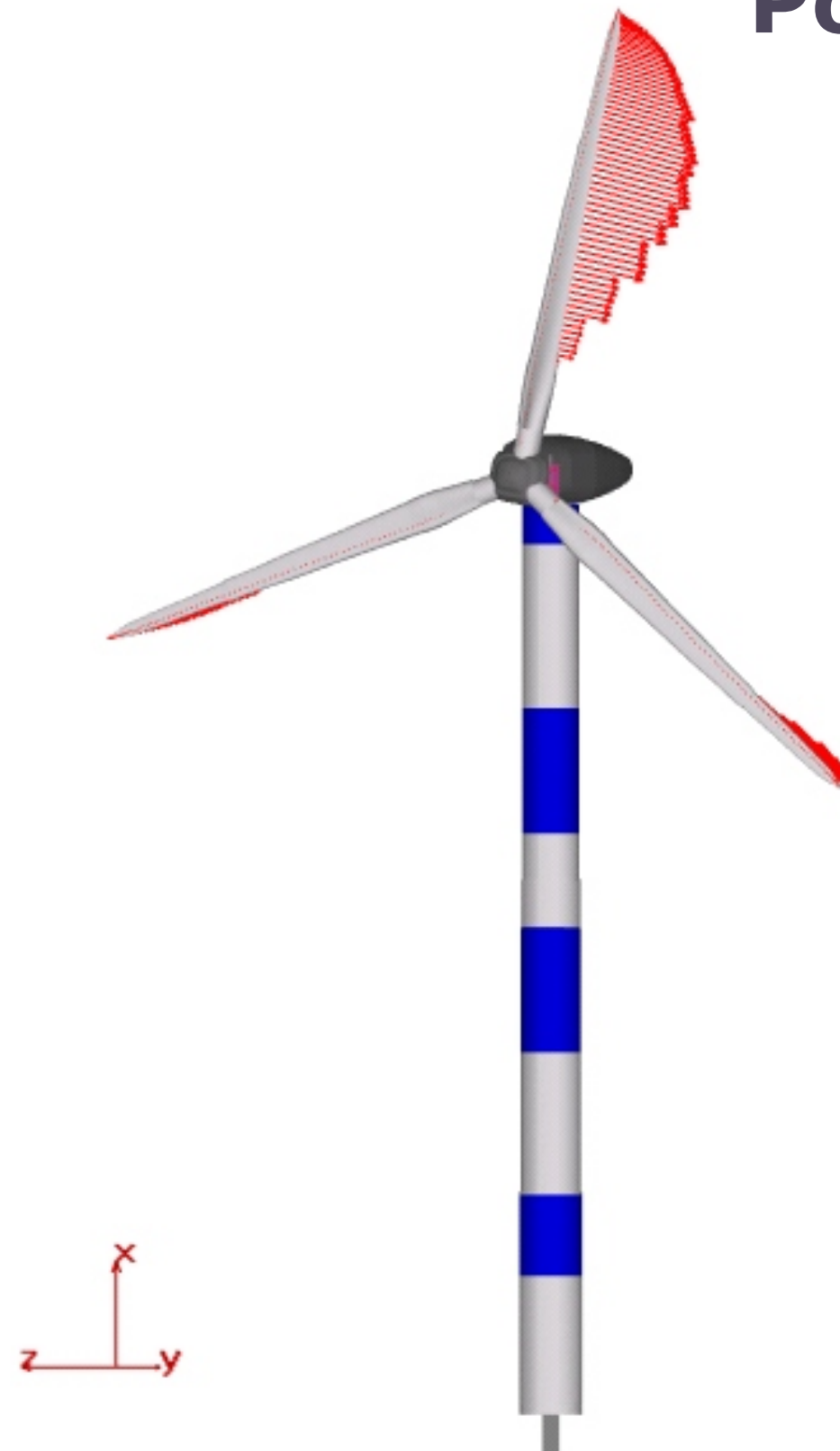
POLITECNICO DI MILANO

DIPARTIMENTO DI INGEGNERIA AEROSPAZIALE
Via La Masa 34
20156 Milano

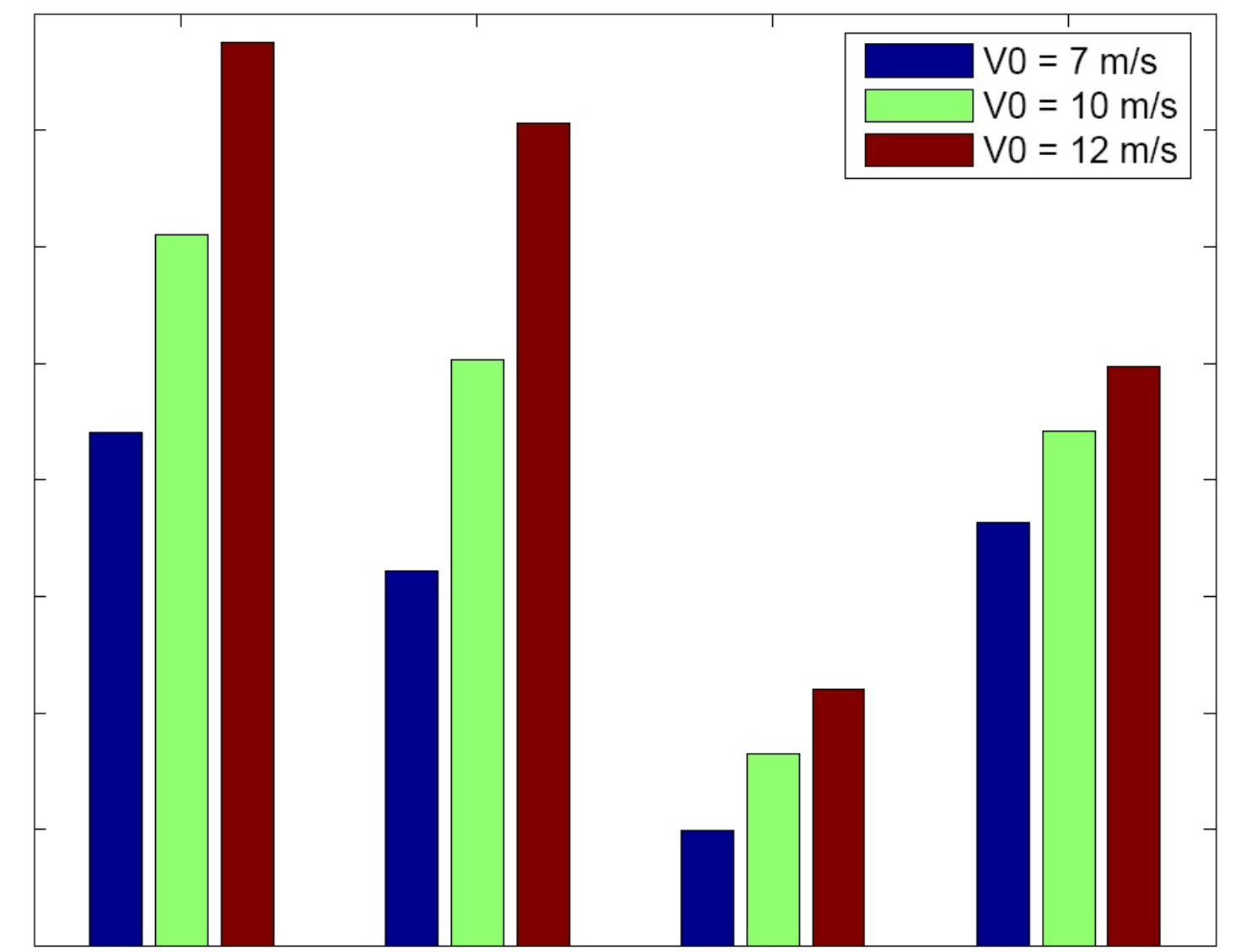
WIND TURBINE MODELING, ANALYSIS AND DESIGN AT DIA-POLIMI

Point of contact:
E-mail:
Phone:

Prof. Carlo L. Bottasso
carlo.bottasso@polimi.it
+39 02 2399 8315



Snap-shot of turbine model operating in gusty and turbulent wind



Fatigue-equivalent tower-root loads for various design configurations

DESIGN

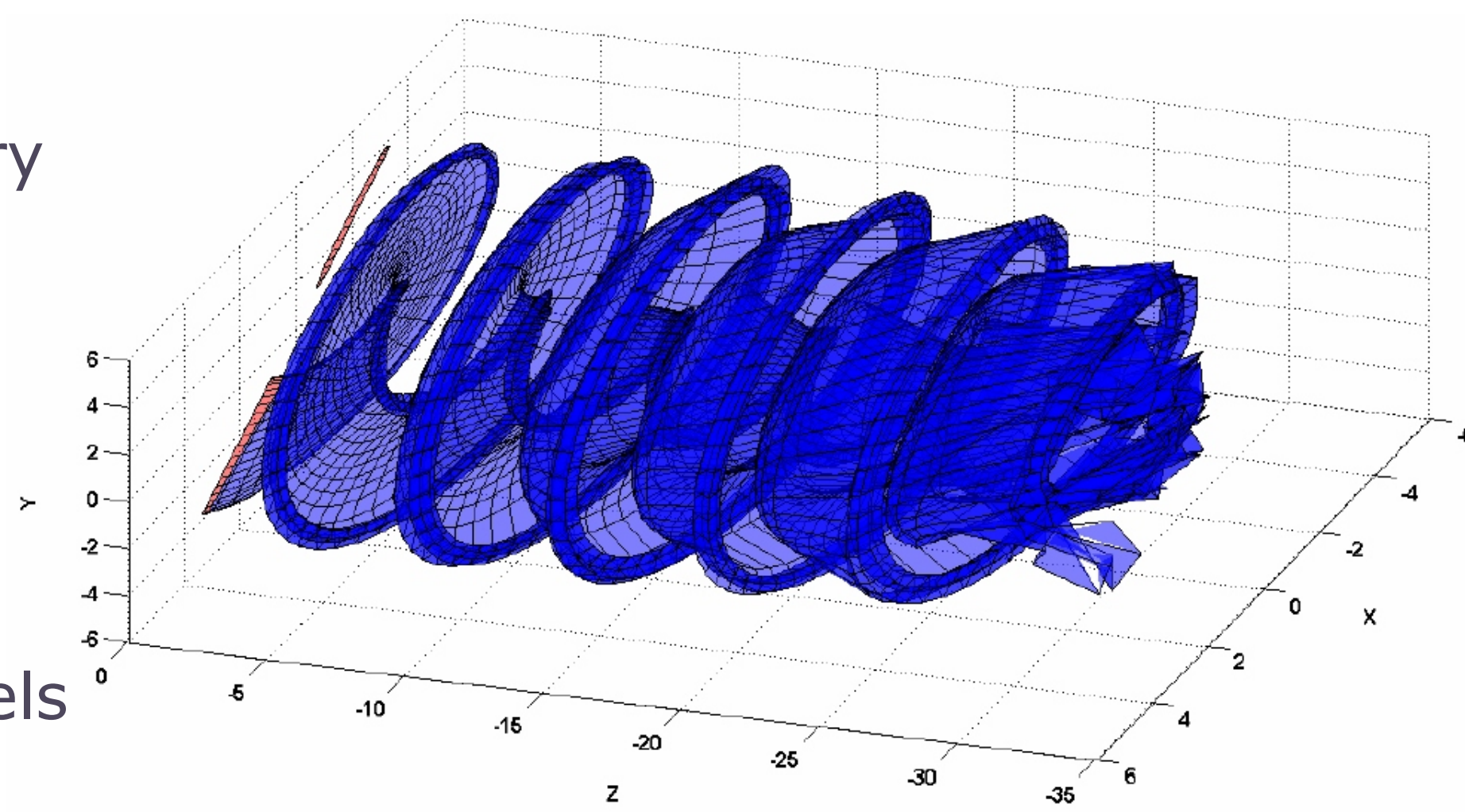
Areas of expertise:

- Aero-servo-elasticity of rotors
- Design and configuration optimization of vertical and horizontal axis turbines
- Performance analysis

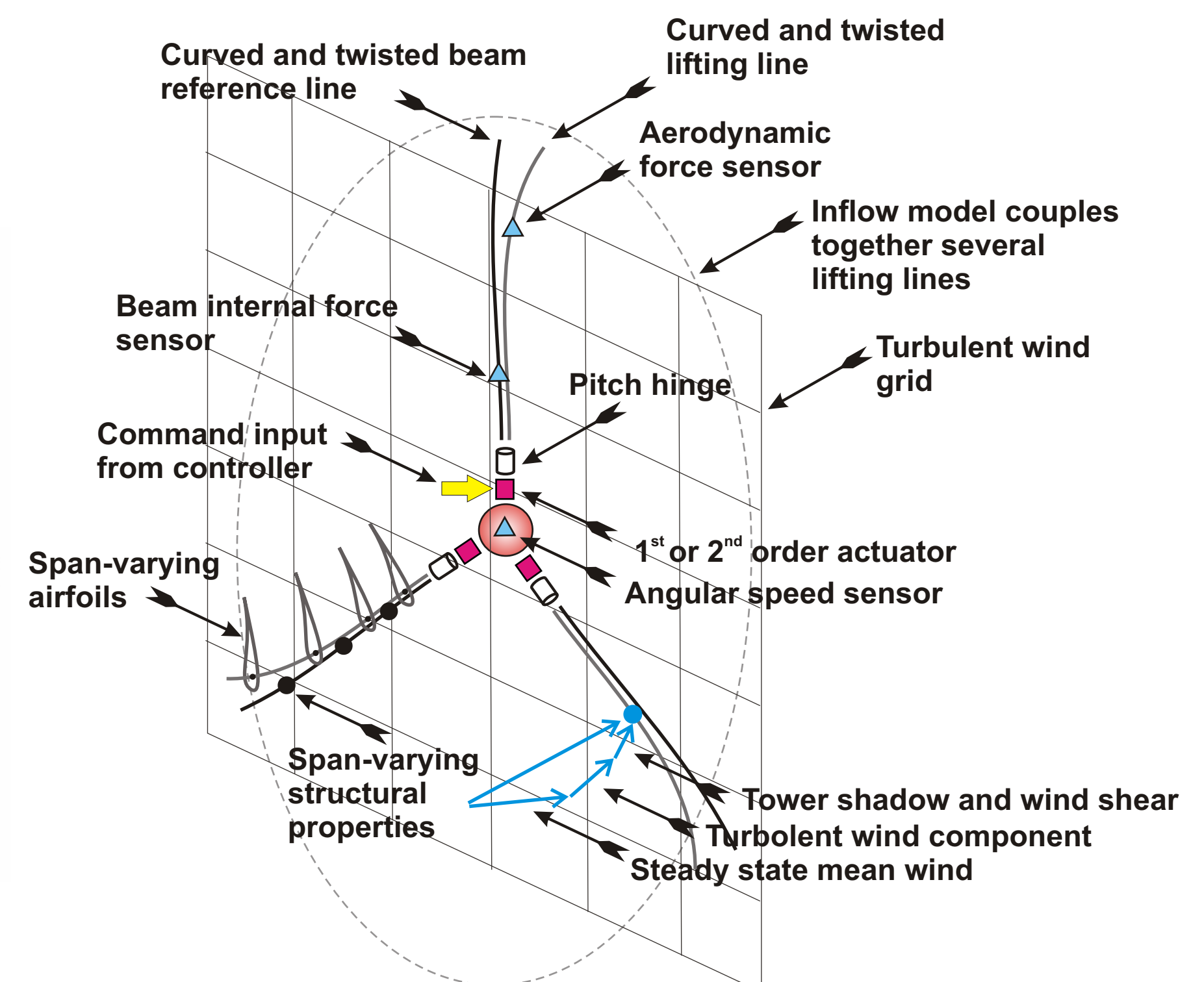
MODELING AND ANALYSIS

In-house-developed modeling tools:

- Finite element multibody procedures applicable to arbitrary turbine configurations
- Sensor and actuator models
- Aerodynamic models
- IEC wind models
- Aerodynamic noise assessment tools
- Coupled aero-servo-elastic models
- Reduced models for predictive control
- Parameter identification software



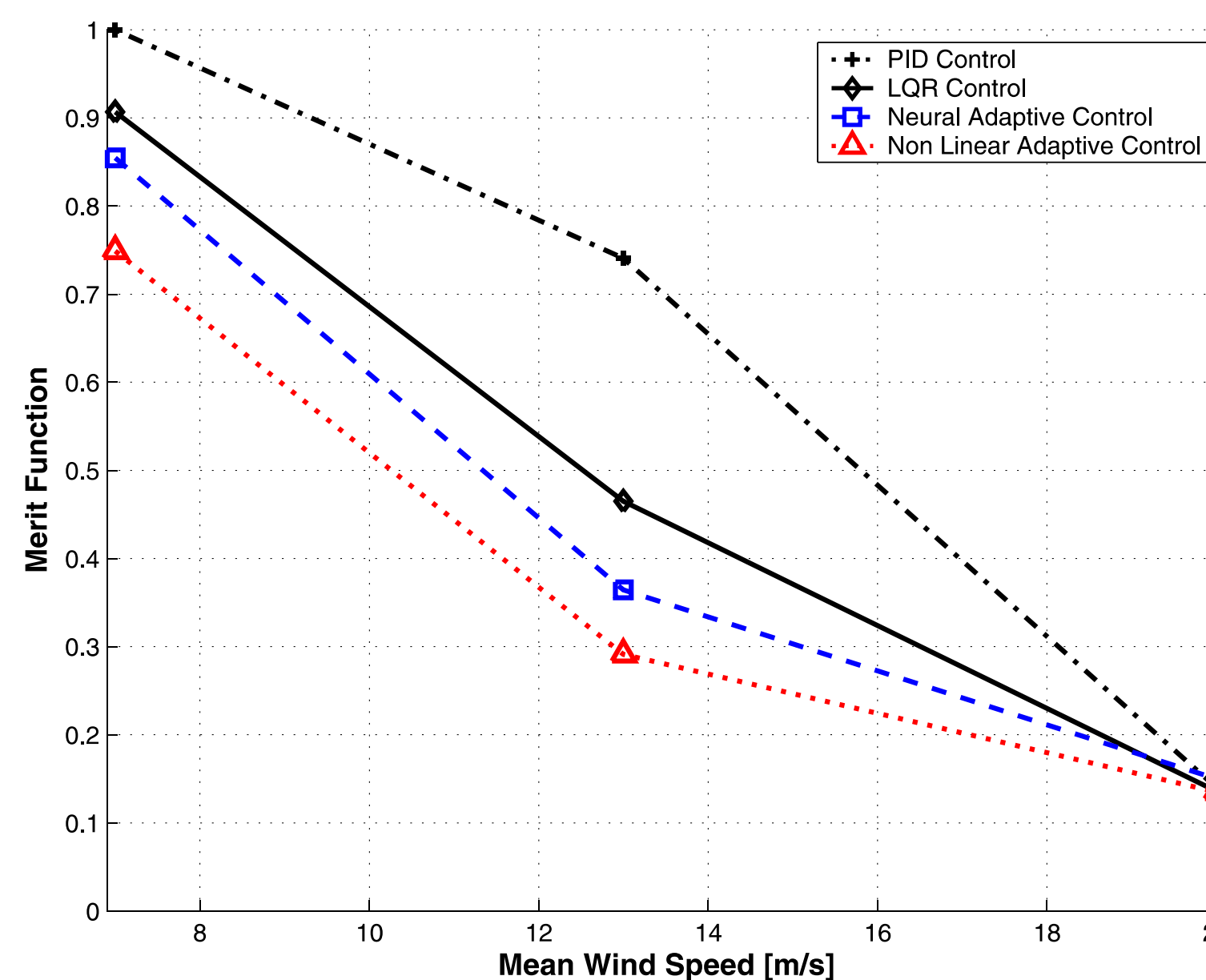
Free-wake modeling



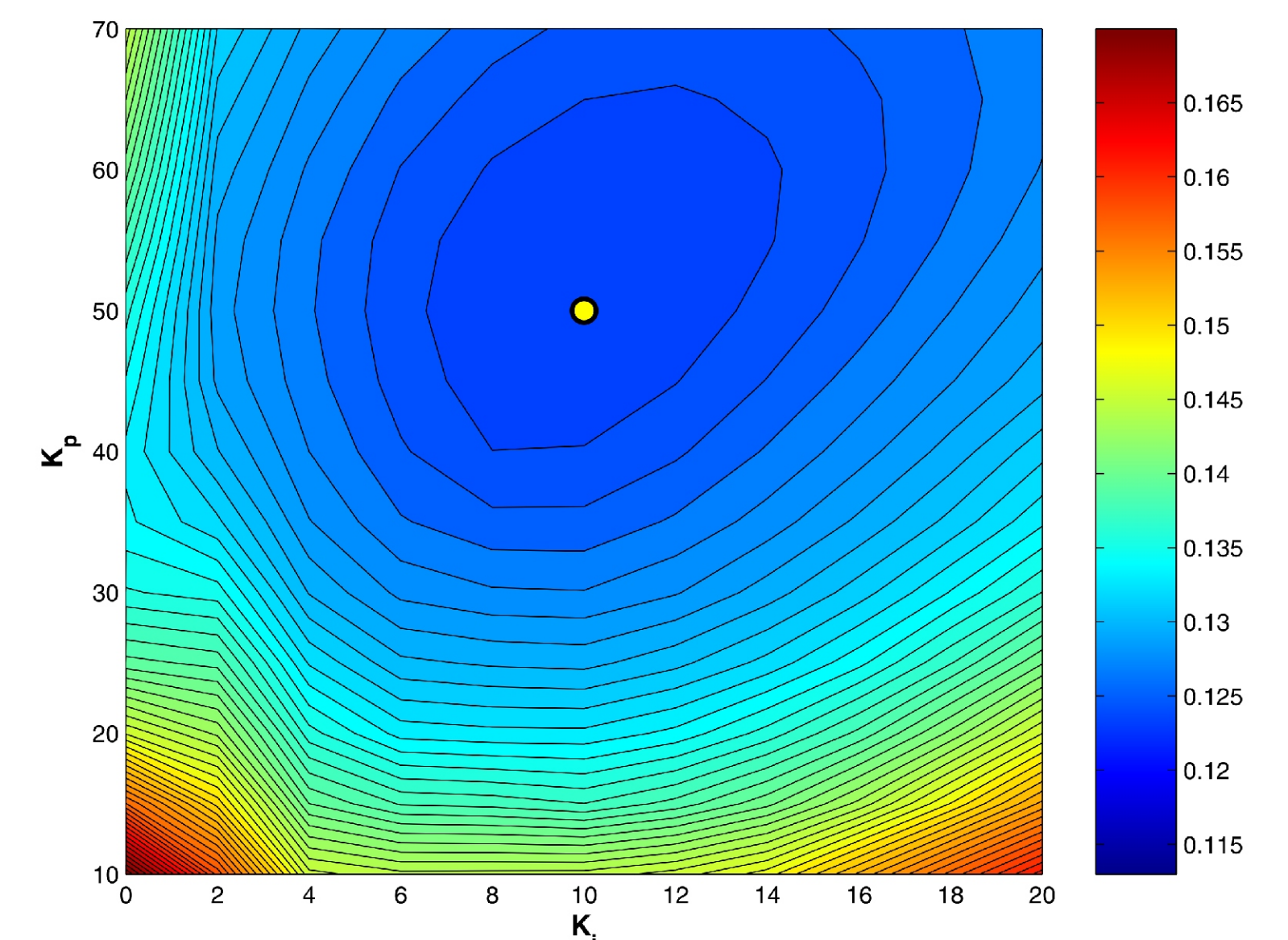
Aero-structural model of rotor

ACTIVE CONTROL

- Development of pitch control schemes
- Optimization of PID control gains
- Application of linear and non-linear predictive control
- Adaptive control
- Real-time implementation on embedded hardware
- Turbine state reconstruction and prediction through Extended Kalman Filtering



Comparison of various control technologies



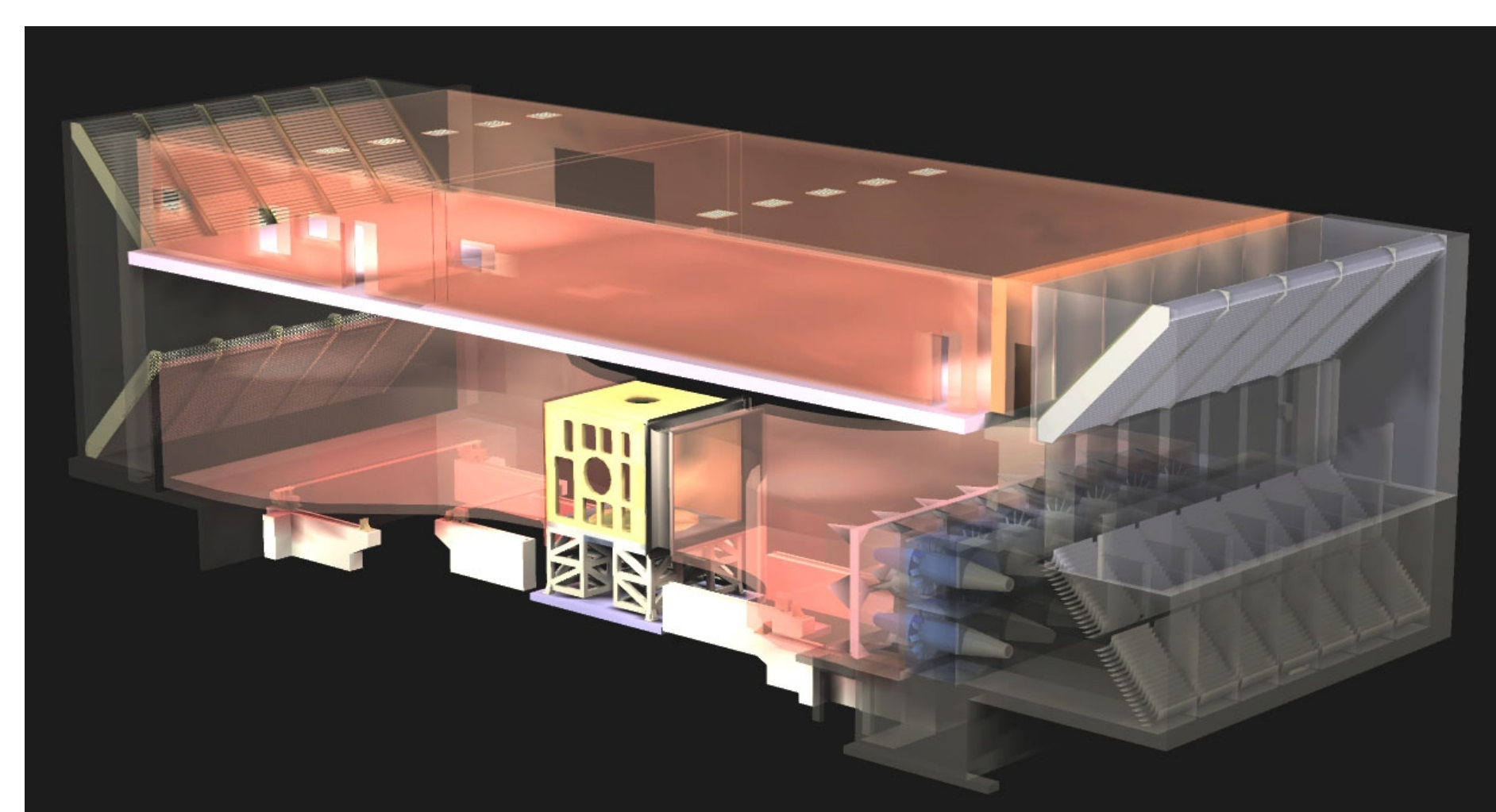
Optimization of PI gains based on user-specified performance indexes

DEPARTMENTAL LABORATORIES

- Structures and structural dynamics
- Material characterization and testing
- Composite materials
- Aerodynamic labs, including the 1.4MW Civil-Aeronautical Wind Tunnel (CAWT):
 - ★ 4x3.84m low turbulence chamber, max speed 55m/s
 - ★ 13.84x3.84m boundary-layer chamber, max speed 14m/s



DIA experimental labs



View of the CAWT facility