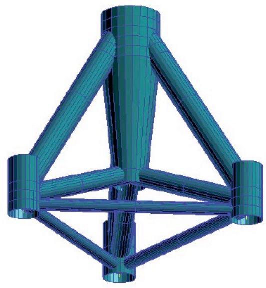
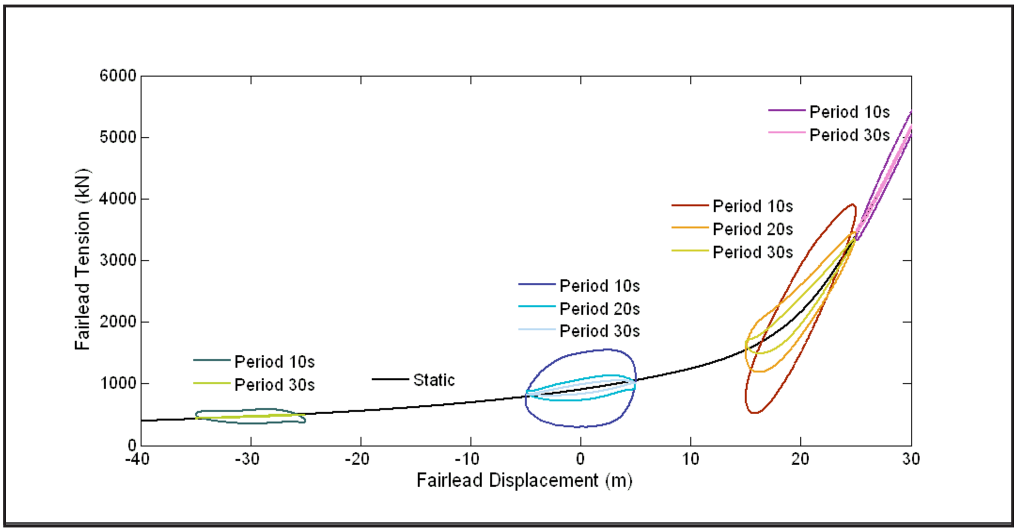
OFFSHORE WIND TURBINES

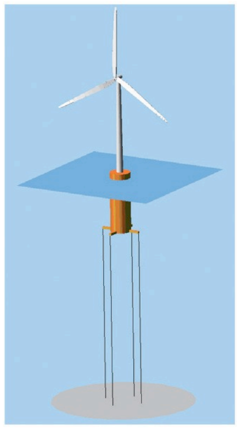
FIXED AND FLOATING PLATFORMS:

- Coupled simulation.
- Substructure design.
- Water tank scale testing support.
- Development of codes for mooring lines dynamics.



Tripod

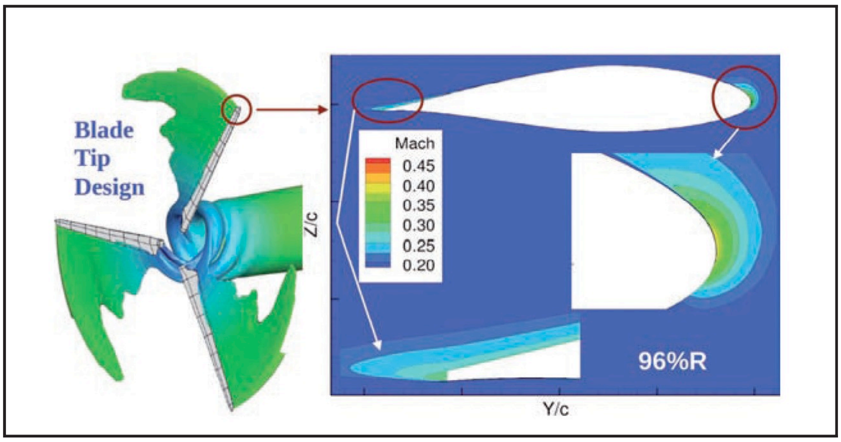




TLP

ROTOR AERODYNAMICS:

- HIGH SPEED
  (COMPRESSIBILITY EFFECTS)



WIND ENERGY DEPARTAMENT

CENER has a wide experience in **simulating dynamics** of different offshore concepts, both fixed bottom and floating platforms as spar buoy, TLP, semisubmersible, etc. **Coupled effects** of aerodynamics, structural dynamics, hydrodynamics, mooring lines and control are considered.

Loads calculated with these simulations provide inputs for the **design** of components and for **certification** purposes.

CENER is also working in the development of codes. OPASS (Offshore Platform Anchoring System Simulator) is a FEM based code for the **dynamic simulation of mooring lines**, considering contact and friction with the seabed. OPASS has been coupled with the FAST code (See an evaluation of dynamic effects over the fairlead tension at the figure at the front top).

New features for offshore applications to the FAST code have been added by CENER, in particular for the simulation of semisubmersible platforms, as a viscous drag model based on Morison Equation.

CENER provides support in the definition and performance of **water tank scale tests** of floating wind turbines including the modelling of the aerodynamic thrust.

Offshore wind turbines need to escape from scaling trend of onshore wind turbines due to their size and accessibility issues. Due to that larger and slender blades, rotating at relatively higher speed are expected in order to extract more efficiently (cheaper at the end) energy from wind.

Nowadays, onshore wind turbines tip speeds are about 0.23Mach (~80m/s,~280Km/h). Offshore wind turbines tip speed could be higher than 0.3Mach (~100m/s, 365Km/h), and the **compressibility effects of** the air should be taken into account in their simulation, due to its impact in the loads and power generation.

The image shown in "Rotor aerodynamics" section on the front page is part of the results obtained at the IEA Task 29: MexNext project, where CENER is actively involved. A tested small wind turbine at the DNW wind tunnel (9.5m x 9.5m) with a tip speed of 100m/s (~0.3M) is analyzed. It can be seen at the leading and trailing edges of the section extracted at 96%R of the rotor, that despite the local Mach number was of 0.3, at suction side, speeds up to 0.4 Mach were observed.

WMB, copressible CFD method developed in collaboration with the University of Liverpool is the method for the adecuate study of these flows. The code is being modified in order to work more efficiently with low Mach number and then a careful validation campaign will follow. The initial target of the new method will be to compute platform-water interactions and employ the results to feed more general but quicker methods for design purposes.