Vibration Analysis of Wind Turbines

- Investigation of vibrations of a wind turbine tower
- Vibration control by using a turned liquid damper

Example of collapse of wind turbine

Analytical model

Natural frequency diagram
(“A”- “E” represent unstable regions.)

Time histories in unstable region E
• Consider the wind turbine which has four DOFs, consisting of the tower translations, $x_0$ and $y_0$, and the inclination angles of the two blades, $\Theta_1$ and $\Theta_2$.

• A cylindrical-type tuned liquid damper (TLD) is installed on a nacelle to suppress the vibration of the tower.

A cylindrical-type TLD works efficiently to suppress the vibrations of the tower at peaks A and C simultaneously.
Vibration Suppression of Wind Turbine Blades Using Pendulum-Type Vibration Absorbers (PVA)

- A pendulum-type vibration absorber (PVA) is installed in turbine blades to suppress the vibration of the blades.
- Several peaks of the blade can be simultaneously suppressed at low amplitudes.
Unstable Vibrations of Blades in Floating Wind Turbines

Unstable regions in the \((\omega, \Omega)\) plane

Simulation:
- ○ Stable
- ● Unstable

Wind Turbine

Blade

Wind

Nacelle

Tower

\[ \omega \]

\[ \theta \]

\[ \Omega \]

Excitation frequency

Rotational speed \(\omega\)

Unstable vibrations