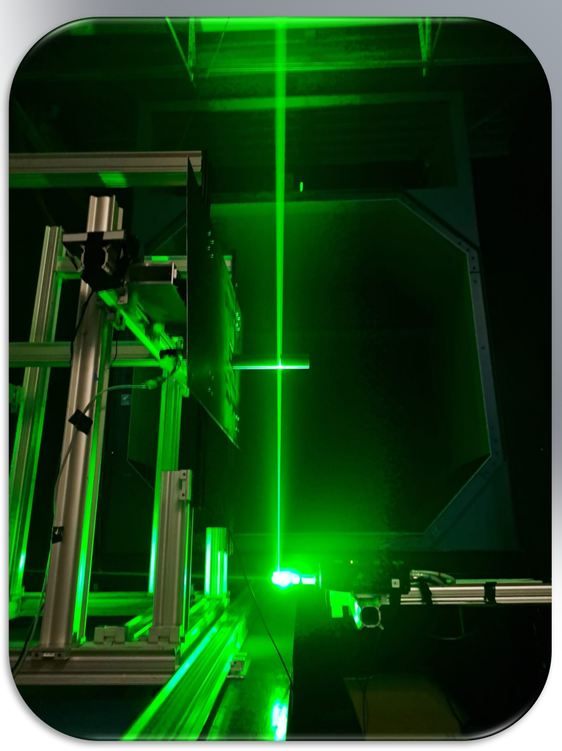
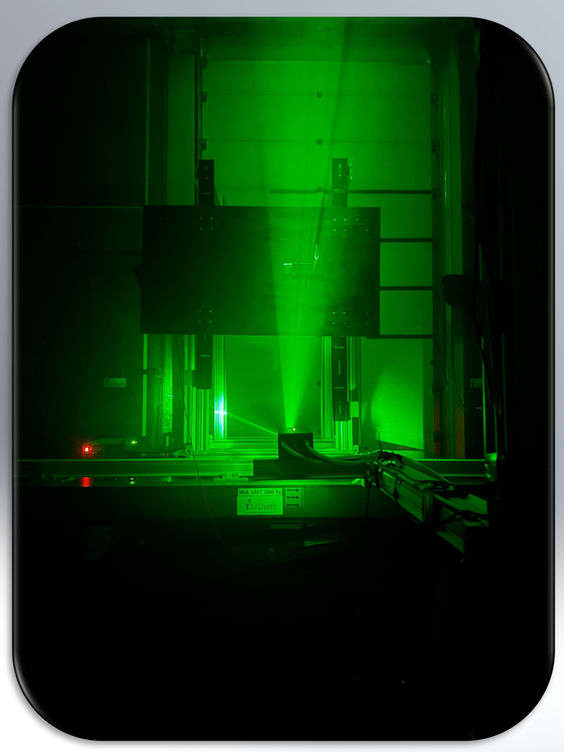
3D aerodynamics of a plunging airfoil at 90° angle of attack

Guanqun Xu
G.Xu-1@tudelft.nl
Aerospace Engineering
Wind Energy Section
Promotor: Carlos Ferreira
Co-promotors: Wei Yu,
Andrea Sciacchitano

What is lock-in effect? Lock-in is a phenomena that occurs when the structural frequency gets close to the vortex shedding frequency.

Why do we focus on lock-in? On a wind turbine blade, vortex-induced vibration (VIV) occurs at lock-in, which could increase the fatigue load, and thus leads to turbine failure.

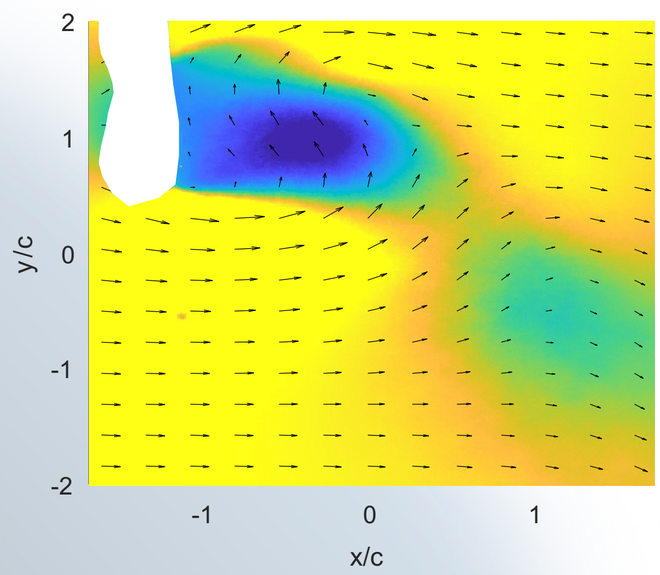


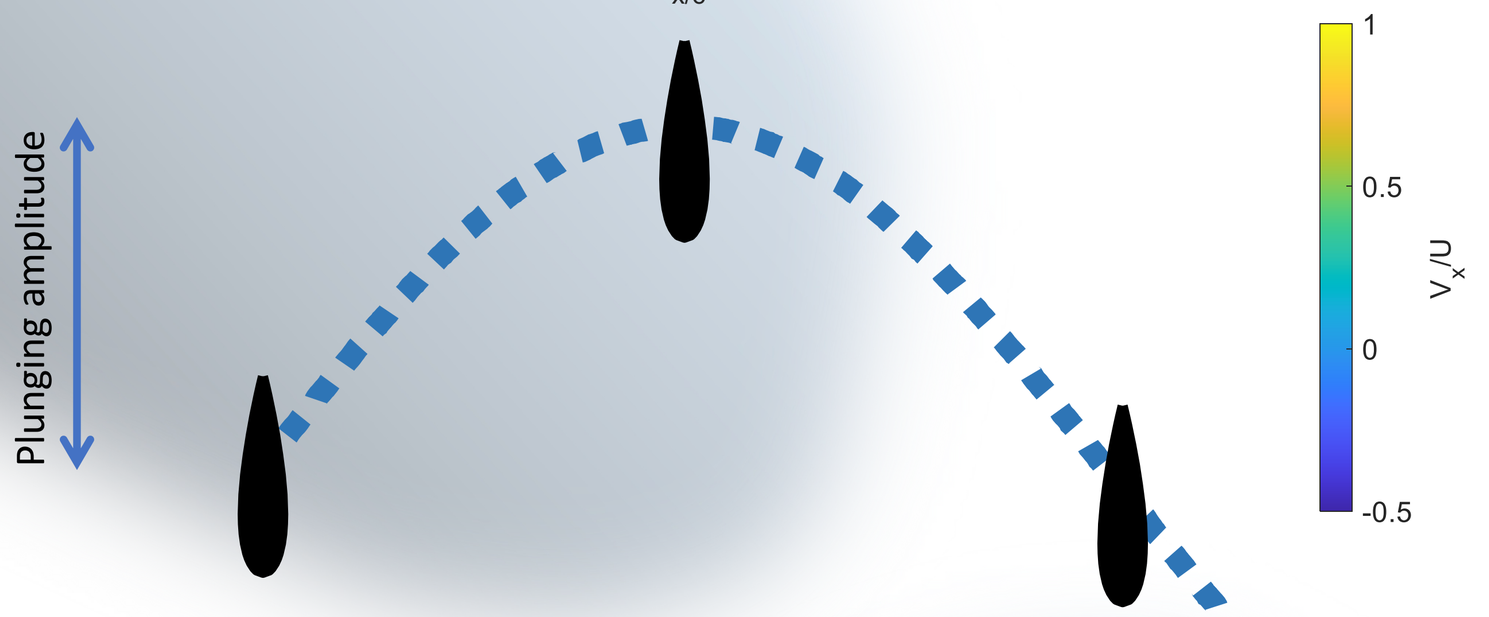


Parameters overview

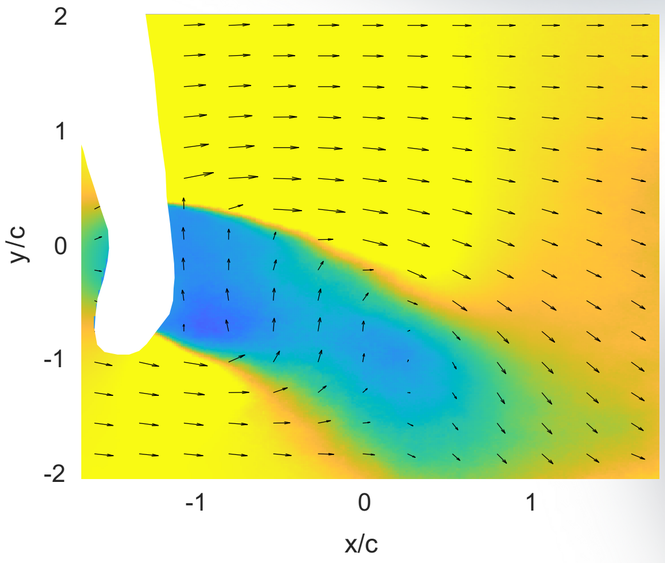
Motion	Plunging, surging
Motion frequency	2.5 Hz, 5 Hz
Motion amplitude	7.5 cm
Data acquisition method	Phase-locking
No. of phase per cycle	12
Model	NACA0021
Chord length	7.5 cm
Span	40 cm

This research aims to experimentally study lock-in related **vortex shedding phenomenon** of airfoil undergoing **pre-defined motion.**

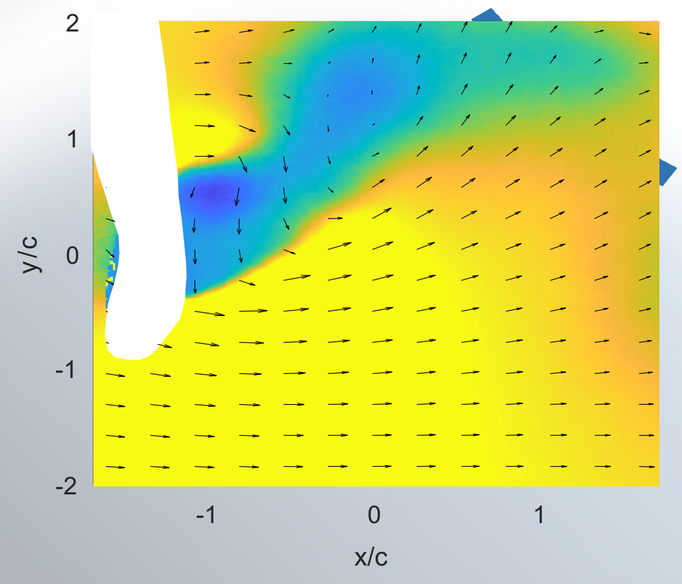




The orientation of the airfoil wake is dependent on the phase of the plunging motion.



At 0°, plunging motion has a potential to go up thus skewing the wake downward.



At 180°, the airfoil is still plunging downward, thus skewing the wake upward.

TU Delft