

Fluid Dynamics + Turbulence (fall 2017)

Homework Problems IV + voluntary Exercises

Posted:

Friday September 22, 2017.

Deadline for submission of homework problem:

Tuesday October 03 at 01.15 pm (on Blackboard).

Homework problem 4: Lift forces on a half-buried cylindrical worm

A cylindrical worm with radius 3 mm lies half buried in sand at the bottom of a river. Its density is 10% higher than the density of water. The water is streaming over the worm. Calculate the critical water speed at which the worm is lifted out of the sand.

Hints: Use the results from an ideal flow around a cylinder. Use cylindrical coordinates. Determine the velocity at the cylinder surface. Use Bernoulli's equation to determine the pressure on the cylinder surface, from which you can calculate the lift force acting on the worm.

1 Exercise problem 4.1

Read the Sections 7.5 and 14.1-7 in the book PK Kundu, IM Cohen + DR Dowling: Fluid Mechanics (see the folder "Miscellaneous Reading" on the course homepage) on aerodynamics and airfoils.

2 Exercise problem 4.2

This "exercise" requires your presence on Tuesday 03 October 03.00-04.30pm! Kun is going to give a short mandatory lecture on the rotor blade design of wind turbines. It has to do with lift forces and the classical Betz theory of wind turbines.