Faculty of Computers, Informatics and Microelectronics

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APA

Laboratory work # 1

Name of the 1st Laboratory Work

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October 6, 2015

1 Introduction

1.1 Topic

The name of the laboratory work

1.2 Task

- 1st task
- 2nd task
- 3rd task

2 Implementation

2.1 Questions

- Q1
- Q2

2.2 Conclusion/Results

2.3 Examples of formulas

Below is a text with some formulas. You should specify each variable being used, unless this variable was not mentioned in a formula mentioned befiore.
Consider a symmetric profile of a hydrodynamic blade in a fluid flow with uniform velocity $\overrightarrow{V}_\infty$. In the fixing point of the symmetric blade with the boom OO' we consider two coordinate systems, namely: the $O'xy$ system with axis $O'y$ oriented in the direction of velocity vector $\overrightarrow{V}_\infty$, and axis $O'x$ normal to this direction; and the $O'x'y'$ system with axis $O'y'$ oriented along the boom direction OO', and axis $O'x'$ normal to this direction. Points A and B correspond to the trailing edge and the leading edge, respectively. The angle of attack α is the angle between the profile chord AB and $\overrightarrow{V}_\infty$, and the positioning angle φ is the angle between the boom OO' and $\overrightarrow{V}_\infty$.
The hydrodynamic force $\overrightarrow{F}$ has its lift and drag components in directions $O'x$ and $O'y$, respectively, given by:

$$F_L = \frac{1}{2} C_L \rho_\infty V_\infty^2 S_p, \tag{1}$$

$$F_D = \frac{1}{2} C_D \rho_\infty V_\infty^2 S_p, \tag{2}$$

where ρ is the fluid density, V_∞ is the flow velocity, $S_p = ch$ (c is the chord length, h is the blade height) represents the lateral surface area of the blade, and C_L and C_D are the dimensionless hydrodynamic coefficients, lift and drag coefficients, respectively. Coefficients C_L and C_D are dependent

on the angle of attack α, the Reynolds number Re and the hydrodynamic shape of the blade profile. The components of the hydrodynamic force in the coordinate system $O'x'y'$ are given by

$$F_{x'} = -F_L \sin\varphi + F_D \cos\varphi, \tag{3}$$
$$F_{y'} = F_L \cos\varphi + F_D \sin\varphi, \tag{4}$$

where F_L and F_D are determined form relations (1) and (2).
The torque at the rotor axis O developed by the blade i is

$$T_{r,i} = F_{x'} \cdot |OO'| \tag{5}$$

and the total torque developed by all blades

$$T_{r\Sigma} = \sum_{i=1}^{N_b} T_{r,i}, \tag{6}$$

where N_b is the number of the rotor's blades.
Since the hydrodynamic force with components (3–4) does not have its application point in the origin of the blade axis system O', it will produce a pitching moment with respect to a reference point chosen to be located at $\frac{1}{4}$ of the chord distance from the leading edge. The pitching moment, is computed by

$$M = \frac{1}{2} C_M \rho_\infty V_\infty^2 c S_p \tag{7}$$

where C_M represents the pitching moment hydrodynamic coefficient.

2.4 Examples of tables

You might use a large variety of styles for tables. Don't forget to refer to the tables in the text and comment them.

Table 2.1: Estimation for computational effort associated to RANS and LES methods

Method	Cells	Timesteps	No. of internal ops per timestep	Relativ effort compared with RANS
RANS	$\approx 10^6$	$\approx 10^2 - 10^3$	1	1
LES	$\approx 10^9$	$\approx 10^5$	$1 - 10$	$\approx 10^5 - 10^6$

2.5 Examples of listings

The listings of the code can be inserted using the package listings and setting up your own style, that will enhance greatly the readability of your code. The style for listing is defined in the thesis style fyle. For more details check `http://en.wikibooks.org/wiki/LaTeX/Source_Code_Listings` or listings package documentation. Below there are presented two examples. In listing 1 the code is taken directly from the file, while in the second example the code is inserted directly in the text, see listing **??**.

Table 2.2: Discretisation parameters for windrose wheel surface

	Element Size	Curvature Normal Angle	Growth Rate
Hub	9 mm	10^o	1,17
Root	$4,5$ mm	4^o	1,17
TLE	$0,7$ mm	1^o	1,135
Tips	$0,4$ mm	1^o	1,135
Blades	$8,5$ mm	5^o	1,165

Listing 1: Java example, code is included from a fyle

```
class ViewFacade {
// ... code removed ...
public void mousePressed(MouseEvent e) {
      selectedView.selectHandle(e.getX(), e.getY());
   }

   public void mouseDragged(MouseEvent e) {
      if (selectedView.moveSelected(e.getX(), e.getY()))
      {
         panel.repaint();
      }
   }

   public void mouseClicked(MouseEvent e) {
      if (e.getClickCount() == 2)
      {
         if (selectedView == sectorView)
         {
            if (selectedView.switchRotationDirection(e.getX(), e.getY()))
            {
               panel.repaint();
            }
         }
      }
   }
// ... code removed ...
}
```

2.6 Examples of images

Figure I.1: Evolution of the aerodynamic tunnel simulations versus the CFD simulations

Fig. 1 Name of the figure 1