Emmanuel PLAUT

Example of an hypertext Report written with LaTeX

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Contents

Introduction

This is an example of a report that you can download on the web page

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Please ***modify*** it !

Nancy - May 7, 2021.

Emmanuel PLAUT.

Chapter 1

Presentation of the corporation

I am a Professor at Université de Lorraine (UL) and Researcher in LEMTA. My CV is available in the appendix A.

1.1 UL

The *Université de Lorraine* is a great French University that contains ten Engineering Schools. I teach in one of them, the ENSMN.

1.2 ENSMN

ENSMN is the *École Nationale Supérieure des Mines de Nancy.*

1.2.1 Logo

I present the logo of ENSMN on figure 1.1.

Fig. 1.1 : Note that the Figure number appears in bold font and that the caption appears with a small font.

1.3 Lemta

Lemta is the *Laboratoire d'Énergétique et de Mécanique Théorique et Appliquée.* It depends on the *Centre National de la Recherche Scientifique* (CNRS) and on the UL.

Fig. 1.2 : This Figure appears at the top of the page because of the option [t] in the latex file.

1.3.1 Logo

I present the logo of Lemta on figure 1.2.

Chapter 2

Presentation of my work

2.1 Teaching activities

Presently one of the most sophisticated topics that I teach concerns ***Turbulence modelling***. I give you here a copy of a part of a recent version of the chapter 0 of Plaut *et al.* (2021). In this chapter, I recalled the bases of the theory that describes the ***dynamics of incompressible newtonian fluids***.

The ***eulerian velocity field*** $\mathbf{v}(\mathbf{x}, t)$ is used to describe the flow of ***incompressible newtonian fluids***. The ***incompressibility*** means that the ***mass density*** ρ is uniform and constant. Therefore the ***mass conservation equation*** reads

$$\boxed{\partial_{x_i} v_i \;=\; 0} \;, \tag{2.1}$$

which means that the velocity field $\mathbf{v}$ is conservative.
The ***Cauchy stress tensor*** $\boldsymbol{\sigma}$ determines the surface force $d^2\mathbf{f}$ exerted on a small surface of area d^2A and normal unit vector $\mathbf{n}$ pointing outwards, by the exterior onto the interior, through

$$d^2\mathbf{f} \;=\; \boldsymbol{\sigma}\cdot\mathbf{n}\; d^2A \;=\; \sigma_{ij} n_j\; d^2A\; \mathbf{e}_i \;. \tag{2.2}$$

The stresses σ_{ij} are given by the sum of ***pressure*** and ***viscous stresses***,

$$\sigma_{ij} \;=\; -\,p_{\text{static}}\delta_{ij} \;+\; 2\eta S_{ij}(\mathbf{v}) \tag{2.3}$$

with p_{static} the ***static pressure***, η the ***dynamic viscosity*** of the fluid, $\mathbf{S}(\mathbf{v})$ the ***rate-of-strain tensor*** defined as the symmetric part of the velocity gradient, i.e., in components,

$$\boxed{S_{ij}(\mathbf{v}) \;:=\; \frac{1}{2}(\partial_{x_i} v_j + \partial_{x_j} v_i)} \;. \tag{2.4}$$

In this equation, the sign := means a definition.
The linear momentum equation is the ***Navier-Stokes equation***

$$\rho[\partial_t v_i \;+\; \partial_{x_j}(v_i v_j)] \;=\; \rho g_i \;+\; \partial_{x_j}\sigma_{ij} \;=\; \rho g_i - \partial_{x_i} p_{\text{static}} \;+\; \partial_{x_j}(2\eta S_{ij}(\mathbf{v}))\;, \tag{2.5}$$

where g_i are the components of the acceleration due to gravity. Usually, a ***modified pressure*** that includes a gravity term,

$$p \;=\; p_{\text{static}} \;+\; \rho g Z \;, \tag{2.6}$$

where Z is a vertical coordinate, is used, to group the first two terms on the r.h.s. of equation (2.5), which reads therefore

$$\boxed{\rho[\partial_t v_i \;+\; \partial_{x_j}(v_i v_j)] \;=\; -\,\partial_{x_i} p \;+\; \partial_{x_j}(2\eta S_{ij}(\mathbf{v}))} \;. \tag{2.7}$$

We will most often use the modified pressure p instead of the static pressure p_{static} .
After dividing by the mass density, we get another form of the ***Navier-Stokes equation***,

$$\boxed{\partial_t v_i \;+\; v_j \partial_{x_j} v_i \;=\; -\,\frac{1}{\rho}\partial_{x_i} p \;+\; \partial_{x_j}(2\nu S_{ij}(\mathbf{v}))} \tag{2.8}$$

with $\nu \;=\; \eta/\rho$ the ***kinematic viscosity*** of the fluid. We have used the mass conservation equation (2.1), $\partial_{x_j} v_j = 0$, to rewrite the nonlinear term on the l.h.s.; this whole l.h.s. is in fact the acceleration of the fluid particle (in the sense of the continuum mechanics) that passes through $\mathbf{x}$ at time t...

2.2 Research activities

I try to advance the study of the nonlinear dynamics of extended systems. For instance I developed for this purpose a reformulation of the Reynolds stress tensor $\boldsymbol{\tau}$ created by pure bidimensional waves at the lowest nonlinear order. This work has been published in Plaut *et al.* (2008). It helps to analyze the instability mechanisms in shear flows, by pushing farther the study performed by Pedlosky (1987), or to better understand the form of zonal flows in rotating convection, see e.g. Morin & Dormy (2006). In Cartesian geometry xy, with x the periodic direction of the wave, the reformulation reads as follows:

$$\tau_{xx} \;=\; -\,2E_{cx} \;, \quad \tau_{yy} \;=\; -\,2E_{cy} \;, \quad \tau_{xy} \;=\; \tau_{yy}\; \tan\alpha \;. \tag{2.9}$$

There

$$E_{cx} \;=\; \frac{1}{2}\left\langle v_x^2 \right\rangle_x \;, \quad E_{cy} \;=\; \frac{1}{2}\left\langle v_y^2 \right\rangle_x \tag{2.10}$$

are the mean kinetic energies associated to the x and y components of the wave velocity field, α is the angle between the wave separatrices and the y direction.

Task	Teaching	Research
Theoretical proportion	50%	50%
Experimental observation	$52 \pm 1\%$	$48 \pm 1\%$

Tab. 2.1 : Sketch of the partition of my working time between Teaching and Research. Teaching activities also encompass duties linked to my responsibilities, as the Head of an Option of Mines Nancy.

2.3 Organization

In table 2.1 I sketch the partition of my working time between Teaching and Research. This partition has evolved with time, I am happy to verify in 2021 an 'equipartition principle' !

Conclusion

I wish you a good play with LaTeX...

Appendix A

Curriculum Vitae

A.1 Initial training

1989 : École Polytechnique, Palaiseau, France

1992 : DEA (Master) of Theoretical Physics, Paris, France

1996 : PhD in Physics, Université d'Orsay, France

A.2 Career

1996-1998 : Post-doc at the Theoretical Physics Institute of the University of Bayreuth, Germany

1998-2008 : Assistant professor at École Nationale Supérieure d'Électricité et de Mécanique (ENSEM), France

2008-... : Professor at ENSMN, France

1998-... : Researcher in Lemta

A.3 Main responsibility

Responsibility of the option Energy & Fluid Mechanics at ENSMN.

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PEDLOSKY, J. 1987 *Geophysical fluid dynamics*. Springer-Verlag.

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PLAUT, E., PEINKE, J. & HÖLLING, M. 2021 *Turbulence & Wind Energy*. Cours de Mines Nancy (3A), http://emmanuelplaut.perso.univ-lorraine.fr/twe/pol.pdf.