BASICS OF ENGINEERING TURBULENCE

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DEDICATION

The meaning of an endeavor is found in the process, more so than the final outcome. This book is dedicated to those who attempt to make the best out of everyday turbulence.

'Yesterday is history, tomorrow is a mystery, today is a gift of God, which is why we call it the present.' – Bil Keane

ACKNOWLEDGMENTS

In the absent of fore- and corunners, this book would have been but an anxious dream of starting a marathon without the stamina to cross the finish line. The author is particularly grateful to the strength from above and many individuals who eased this challenging endeavor, giving him the fuel needed to make it through the finish line. These instrumental individuals include the following:

Prof Dr D.J. Wilson, by whom the author was culturally shocked by flow turbulence in 1989. Some parts of this book have been written based on his lecture notes ("Mec E 632 Turbulent Fluid Dynamics," University of Alberta, 1989).

The numerous engineering artists who have supplied the beautiful figures. While their helping hands are explicitly recognized in the figure caption, a general heartfelt thank you goes to the Turbulence and Energy (T&E) Laboratory. Everyone who has contributed, one way or another, is a T&E-er at heart, even though some graduated before the official establishment of the T&E Lab. Also, thanks to many of my T&E colleagues – even Dr Rupp Carriveau, who stole the spotlight with his eloquent exaggerations in the foreword.

The Elsevier publishing team who is responsible for many sleepless nights. It started with Chelsea Johnston and Joseph P. Hayton. The nightmare became particularly real with Carrie L. Bolger. The extremely supportive reviewers are also responsible. In particular, Prof Dr Pierre Sullivan, Prof Dr Himanshu Tyagi, and the overly positive Prof Dr Alain deChamplain and Alain Fossi.

The Turbulent flow graduate classes of 2012, 2014, and 2015, especially those who picked up the many less-than-obvious errors scattered over the two versions of self-published lecture notes. During the final round, Jamie C. Smith went through each sentence and objected to countless "leap-of-faith" wordings, Sai Praneeth Mupparapu checked every tilde in the equations, and Hao Wu combed out whatever debris he came across.

Mom, dad, sisters, and brother, and Uncle Mitchell and the other founding members of the Allinterest Research Institute; fluid dynamics is still turbulenting my heart after all these years.

Naomi, Yoniana, Tachelle, and Zarek Ting for their unfailing love and continual encouragements, especially those conveyed via many philosophical sarcasms. They were there from the groundbreaking days of the first (self-published) version of this book with Naomi Ting's Books. It has been a long but rewarding journey together.

FOREWORD

Turbulence can be a very beautiful thing, a dynamic cascade of scales that connects us to each other and our environment. Occasions to study turbulence are abundant; examples flow from our bodies to the heavens. Opportunities for true understanding are considerably less ample. Sir Horace Lamb himself once famously quipped that on reaching heaven he hoped for divine enlightenment on just two matters: quantum electrodynamics and turbulence. He said he was "rather optimistic of the former." One barrier that has challenged more widespread understanding has been the lack of a true bridge to the topic. From the seminal works to most contemporary texts, the treatment of the subject is detailed and advanced. This is perfectly appropriate for select scholars of the science and sufficiently discouraging for the beginner, enthusiast, or cross-disciplinarian looking for application-level understanding. Subsequently, the ranks of the well-informed remain somewhat exclusive.

Enter David Ting. I have had the pleasure and challenge of working with David for the last 11 years. While David's turbulence publication record is impressive in its own right, I have always been more impressed by his dedication and concern for students. More than anyone I have ever known, he is able to simplify, rearrange, and relate complex matters to those lost sheep keen to join the flock of the initiated. When his conventional teaching toolset is not reaching the students, it is his unparalleled faith in them that inspires their personal development. I trust you will enjoy the bridge David has built with this textbook. If you will not subscribe to my endorsement, then please have faith; in the pursuit of turbulence enlightenment, it would seem a minimum requirement.

Rupp Carriveau

Dr Rupp Carriveau is the Associate Professor at the University of Windsor, Lumley Centre for Engineering Innovation. He is the coordinator in the Centre for Energy and Water Advancement and Director in the Turbulence and Energy Laboratory. Dr Carriveau serves on the Editorial Boards of Wind Engineering, Advances in Energy Research, and the International Journal of Sustainable Energy. He is the current President of the Underwater Energy Storage Society. He was recently designated as the University Scholar and has served as the Research Ambassador for the Council of Ontario Universities.

PREFACE

This book is intended for keen minds interested in flowing fluids. Specifically, it aims at removing the "fear of water" from those who are new to flow turbulence. The basic background on everyday flow turbulences, especially those encountered in engineering applications, forms the crux of the book. Some undergraduate knowledge of fluid mechanics and statistics is needed to best appreciate the material covered.

David S-K. Ting
August 14, 2015

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