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Sid-Ahmed Selouani

Speech Processing and Soft Computing

Springer

Sid-Ahmed Selouani
Université de Moncton
Shippagan Campus
218, Boul. J-D Gauthier
Moncton
Canada
selouani@umcs.ca

ISSN 2191-8112 e-ISSN 2191-8120
ISBN 978-1-4419-9684-8 e-ISBN 978-1-4419-9685-5
DOI 10.1007/978-1-4419-9685-5
Springer New York Dordrecht Heidelberg London

Library of Congress Control Number: 2011936520

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

Soft Computing (SC) techniques have been recognized nowadays as attractive solutions for modeling highly nonlinear or partially defined complex systems and processes. These techniques resemble biological processes more closely than conventional (more formal) techniques. However, despite its increasing popularity, soft computing lacks a precise definition because it is continuously evolving by including new concepts and techniques. Generally speaking, SC techniques encompass two main concepts: approximate reasoning and function approximation and/or optimization. They constitute a powerful tool that can perfectly complement the well-established formal approaches when certain aspects of the problem to solve require dealing with uncertainty, approximation and partial truth. Many real-life problems related to sociology, economy, science and engineering can be solved most effectively by using SC techniques in combination with formal modeling. This book advocates the effectiveness of this combination in the field of speech technology which has provided systems that have become increasingly visible in a wide range of applications.

Speech is a very complex phenomenon involving biological information processing system that enables humans to accomplish very sophisticated communication tasks. These tasks use both logical and intuitive processing. Conventional 'hard computing' approaches have achieved prodigious progress, but their capabilities are still far behind that of human beings, particularly when called upon to cope with unexpected changes encountered in the real world.

Therefore, bridging the gap between the SC concepts and speech technology is the main purpose of this book. It aims at covering some important advantages that speech technology can draw from bio-inspired soft computing methods. Through practical cases, we will explore, dissect and examine how soft computing complement conventional techniques in speech enhancement and speech recognition in order to provide more robust systems.

This book is a result of my research, since 2000, at INRS-EMT Research Institute (Montreal, Canada) and LARIHS Laboratory in Moncton University (New Brunswick, Canada). Its content is structured so that principles and theory are often followed by applications and supplemented by experiments. My goal is to provide a cohesive vision on the effective use of soft computing methods in speech enhancement and speech recognition approaches.

The book is divided into two parts. Each part contains four chapters. Part I is entitled *Soft Computing and Speech Enhancement*. It looks at conventional techniques of speech enhancement and their evaluation methods, advocates the usefulness of hybridizing hierarchical connectionist structure with subspace decomposition methods, as well as the effectiveness of a new criterion to optimize the process of the subspace-based noise reduction. It also shows the relevance of evolutionary-based techniques in speech enhancement. Part II, *Soft Computing and Speech Recognition*, addresses the speech recognition robustness problem, and suggests ways that can make performance improvements in adverse conditions and unexpected speaker changes. Solutions involving Autoregressive Time-Delayed Neural Networks (AR-TDNN), genetic algorithms and Karhunen Loève transforms are explained and experimentally evaluated.

It is my hope that this contribution will both inspire and succeed in passing on to the reader my continued fascination with speech processing and soft computing.

Shippagan (NB), Canada Sid-Ahmed Selouani

Contents