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Haptics Technologies

Bringing Touch to Multimedia

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*For my sweethearts for the joy they bring me.
To my fellow learners (teachers and students)
in the lifelong learning journey.
– Abdulmotaleb El Saddik*

*To my parents, Maria and my daughters
Valeria and Ximena.
– Mauricio Orozco*

*To my family and all the young people who
are struggling for freedom and peace.
– Mohamad Eid*

*To my family
– Jongeun Cha*

Preface

The first sense that a baby will experience is touch. The feelings of warmth, cold, roughness, softness, and hardness are those that we as babies first experienced and responded to.

An Australian woman gave birth to twins but the boy, thirteen weeks premature and weighing only 2lbs, was not breathing. Despite the desperate attempts of the attending medical staff to resuscitate the tiny child, after twenty minutes the doctor handed the baby to the heartbroken mother so that she could have a final cuddle and say her goodbyes.

The mother held the little boy against her skin snuggling, stroking and talking to him while her husband comforted her. Amazingly, after holding the child for two hours, she felt a slight movement from the little body. Gazing at the child she saw that he was breathing and his eyes started to open. The doctor and nurses were at first convinced that the movement was simply the muscular reaction that often occurs in a body after death. The mother, undeterred, moistened the baby's lips with a little breast milk on her finger and was overjoyed when the child tried to suck her finger. The medics were stunned but were later told that this phenomenon is not unique and is known as the 'kangaroo touch'. Being held 'skin to skin', the baby was revived by the warmth of the mother's flesh, at exactly the same temperature, and the feel of her heart beating [Sun Newspaper, August 25, 2010].

Children need affection! Imagine a child, somewhere in this world, for some reason lost connection with his/her loved ones. The traditional ways to maintain such a connection might be simple images or maybe some audio files of their voices. Would it not be exciting to be able to restore the smell, touch, and hug feeling of the child's parent whenever he/she needs their affection? Would it not be amazing to share the parent's physical affection while viewing their picture or hearing their voice recording? Would it not be interesting to recall past memories of childhood by recording and later replaying such physical stimuli?

These ideas have triggered new research into ways of physically recording those expressions of affection. This research covers methods, algorithms, and technologies for understanding, capturing, and transmitting these expressions in a realistic and secure manner.

This book is about haptics as the new media. It describes human haptic perception and interfaces and presents fundamentals in haptic rendering and modeling in virtual environments. The book explains the diverse software architectures for standalone and networked haptic systems. It also demonstrates the vast application spectrum of this emerging technology together with its trends. The primary objective is to provide a comprehensive overview and a practical view of haptic technologies. An understanding of the close relationship among the wide range of disciplines that constitute a haptic system is a key principle toward the successful building of collaborative haptic environments.

This book is different than any other book that has looked at haptics. We look at haptics as a new medium rather than just a domain in human–computer interaction, virtual reality, or robotics. It is structured as a reference book, so it allows for fast accommodation to most of the issues concerned. It is also intended for researchers interested in studying touch and force feedback for use in technological multimedia systems in computer science, electrical engineering, or other related disciplines. Many are searching for the next big haptic idea in research and development areas such as military, gaming, or interpersonal communication.

Ottawa

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Acknowledgments

Knowledge is understanding that a tomato is a fruit. *Wisdom* is not putting it in a fruit salad.

This book can also be described as a long journey since it took 5 years from the idea to the realization. It would not have been completed without the constant support, inspiration, and sacrifice of our families.

A passport of a great journey is usually stamped with funny and memorable moments. Those most beautiful memories happened either in our research laboratories at the University of Ottawa or during our many trips. Having said this, we are particularly thankful of our research fellows at the Multimedia Communications Research Laboratory (MCRLab) and the Distributed & Collaborative Virtual Environments Research Laboratory (DISCOVER). Their research and development helped us to understand a lot of the concepts presented in this book. This is due to the great environment we have in the Faculty of Engineering at the University of Ottawa. In particular, we thank Prof. Emil Petriu.

Special thanks go to Dan Martin, Hussein Alosman, and Genvieve Freeman, who sometimes under extreme time constraints were ready to proofread this work and provide us with suggestions and help. Dan, we thank you for some sleepless nights, particularly during the last few weeks of this journey. Ralf Gerstner from Springer-Verlag also deserves special thanks for his patience while working with us.

During the journey of writing this book, although we were based at the University of Ottawa, we had the opportunity to visit many places for varying lengths of time as visiting researchers or visiting professors. We greatly acknowledge the help and support we received by NSERC, Ontario Centre of Excellence, Ontario Research Fund, Canada Foundation for Innovation, Humboldt Foundations, Consejo Nacional Ciencia y Tecnología (CONACyT), TU Darmstadt, UC III de Madrid, NYUAD, as well as some private hosts during our journey in Seoul, Mexico City, and Beirut. A special acknowledgment goes to Air Canada for providing wireless access in their lounge and for the crew's hospitality while working on this book in the air.

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