Acknowledgments

It has been a most wonderful and overwhelming experience to completing this doctoral work. It is hard to know whether it has been grappling with the mathematics itself which has been the real learning experience, or dealing with how to write a paper, work in a group, give a talk in a meeting, code for problem (and bugs), writing reports for funding, travail with laptop, stay up until the birds start singing, and of course stay focused. I'm grateful for advice, support, encouragement, and friendship of many individuals and of a few organizations who contributed to this dissertation.

I have been very privileged to have undoubtedly the most intuitive, smart and supportive advisor anyone could ask for, namely Kapil Kumar Sharma. Ever since I learned from him what an avoided crossing was, I have been stimulated and excited by his constant flow of good ideas. He has fostered certainly the most open, friendly, and collaborative. He has also known when (and how) to give me a little push in the forward direction when I needed it. His constructive criticism and valuable suggestions at every step of my work has not only shaped the present version but also broadened my perspective during the entire course of my study.

My most intense collaboration has been with Professor Benoit Perthame and Professor Edwige Godlewski from Laboratoire Jacques-Louis Lions, Université Pierre et Marie Curie at Paris in France through French Government Sandwich PhD Fellowship program. Their clarity, persistence, ability to create new models, and ability to write 7-8 new publications every year, has taught me a lot. Professor Benoit Perthame has influenced me, and I think I can safely say that everyone in his group has benefited from his generosity and collaboration. He has an ability to cut through reams of analysis with a single visual explanation that I will always admire, and I have learned a great deal of mathematics from him.

Throughout my doctoral thesis, I was supported for many semesters by the University Grants Commission, and the Council for Scientific and Industrial Research. During my third year I thank the French Government for providing me funding for six months through French Embassy in India, Ministry of Foreign Affairs. I am also
thankful to ÉGIDE Paris for arranging accommodation and managing the fellowship during my stay in Paris. I acknowledge the support provided by National University of Singapore, National Board for Higher Mathematics (India), Pacific Institute for the Mathematical Sciences (Canada), Technische Universität Berlin, University of British Columbia, University of Victoria, University of Warwick, and University of Würzburg for participation in academic activities and visits.

I express my heartiest thanks to Professor A. S. Vasudeva Murthy and Professor G. D. Veerappa Gowda from TIFR Centre for Applicable Mathematics at Bengaluru, India for their invaluable suggestions and always supporting me. I am thankful to my wonderful teachers like Professor Sushil Tomar (current Chairperson of our department) and Professor Vikas Bist for their constant support and encouragement. I am also thankful to all the concerned people in the department for providing the necessary facilities and help during my research work.

On the foreign front, I also must thank Professor Danielle Hilhorst from Université Paris-Sud in Orsay, France for fascinating email exchanges, and guiding me. I am also thankful to Professor Siddhartha Mishra from ETH Zürich in Switzerland for inviting me to visit ETH and having valuable conversations.

The writing of a thesis can be a lonely and isolating experience, yet it is obviously not possible without the personal and practical support of numerous people. One of the greatest joys of this work is that it gives me an opportunity to make some truly wonderful friends who provided a very pleasant working and friendly environment. From the world of Mathematics, Ange and Anuj stand out as both good and caring friends. There are countless others who have been there for me throughout my time as a doctoral student. I am thankful to Anne-Claire, Dilbag, Gurjinder, Laurent, Luna, Natalia, Pierre, Samir, Sarat, Sepideh, Sohail, and Vijai.

A penultimate thanks goes to my wonderful parents. For always being there when I needed them most, and never once complaining about how infrequently I visit, they deserve far more credit than I can ever give them. For my parents who raised me
Acknowledgments

with a love of science and supported me in all my pursuits. Thank you. I would like to thank my brother, both sisters and sister-in-law for all their love, support and encouragement. My late grand parents taught me a lot and it is sad to realize that they cannot be present for this moment in my life.

Lastly but not the least, I am thankful to all those surrounding me on the beautiful campus of Panjab University at Chandigarh who treated me with love and respect which I will always remember.

Chandigarh, March, 2012

(Param Jeet Singh)