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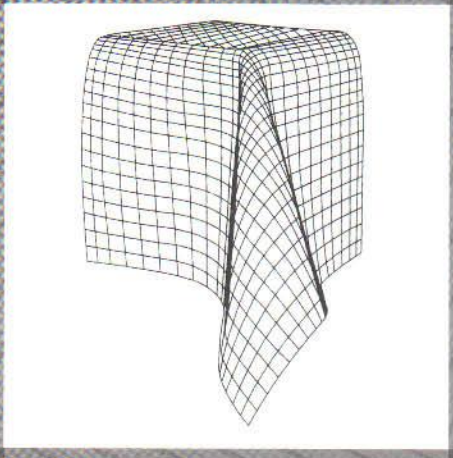

Structure and mechanics of woven fabrics

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Contents

Preface

This book introduces fundamental and advanced fabric structure and mechanics. There are 10 chapters covering the general features of textile structure and mechanics. All the simple modes of deformation such as tensile, bending, shear and compression, and the complex, particularly drape deformation of fabrics (mainly woven), are discussed. Testing methods for the objective/instrumental measurement of fabric mechanical properties and structure parameters are also included.

I am grateful to my PhD supervisor, Dr Alan Newton, in the Textile Department of UMIST. He introduced me to fabric structure and mechanics and, through his extensive academic knowledge in this area, taught me the fascinating science of fibre assemblies.

From my own point of view, mechanics is the most difficult science. I achieved lower marks in this subject than in the other subjects I studied as a bachelor degree student. Fabric mechanics must be the most difficult of all areas of mechanics because all my predecessors and the people I have worked with have said so. It is funny to think that I have picked this area for my research. It is also a very rewarding area to work in for the following reasons:

1. I have benefited from the academic standards and professionalism of many outstanding people: Prof. John Hearle, Prof. Ron Postle, Prof. Ning Pan, Prof. George Stylios, Prof. Tongxi Yu and many more.
2. I have become more versatile and have been able to handle other areas of research much more easily because of my understanding and experience in fabric mechanics. This is because the challenges in this field have helped me to solve problems in other areas such as Shape Memory Materials and Textiles more conveniently and quickly.
3. I have made many friends by carrying out different projects and working with different people from all over the world, from India to Europe, from east to west, from students to outstanding scholars, from Hong Kong and China, and across various disciplines ranging from physics, mechanics, civil and structural mechanics, textiles and clothing, medicine, etc.
4. I feel I am a scientist rather than a textile technologist, and thus have no

psychological barriers in regards to working with people from different disciplines, such as chemistry and physics. This has helped me to open new research areas the past few years.

5. Fabric mechanics has become one of the most popular subjects for research students in the Institute of Textiles and Clothing in the Hong Kong Polytechnic University. This is evidenced by the fact that students continue to select this subject; I offer it every semester to different students.

Indeed, as I tell my students, mechanics is closely related to forces. Can anybody tell me what materials or products are used without applying a force? It is difficult to find any. Every researcher should know some basic facts about mechanics; every research student in clothing and textiles should know something about textile/fabric mechanics. Not only that, textiles have been used for many, many areas because of their unique characteristics, as introduced in Chapter 1. To apply textiles to these areas properly and optimally, an understanding of the structures and mechanics of fabrics is required. This book can be used by people working in many areas, including textile composites, geotextiles, medical textiles, transportation textiles, etc.

Thus, I hope this book will be useful for many people and benefit many sectors of scientific and technological development. In particular, people working in the areas of textiles, clothing, materials, fibrous composites and medical textiles will find this book useful as a reference and/or textbook for studying, research and teaching.

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- Dr Debbie Jiang Xiuying, who helped with editing the first version of this book;
- Mr Xin Binjie also helped in editing the final version of Chapters 2, 3, 8 and 9;
- Candy Wu, who helped in formatting the chapters.

The contents of the book are based on my intensive research work over the past 15 years starting from my PhD study in UMIST, Manchester, UK until now. During this time, my research students and research assistants at the Hong Kong Polytechnic University have helped me with many projects. They are:

- Dr Jane Chung Siu-Ping, whose research into seams is included;
- Dr Winnie Lo Wing-Man, whose study of the anisotropy of woven fabrics has been used in different chapters;
- Dr Chen Shuifu, whose work on the applications of finite-volume methods to the simulation of fabric drape is also included;
- Dr Fengjun Shi, who worked with me for about one year – his modelling of bending and wrinkling using viscoelastic properties is included in Chapter 5.

I have also worked with many outstanding people over the past few years for the work reported in this book. They are:

- Prof. John Hearle, who has helped me since I was a PhD student in UMIST;
- Prof. Ron Postle, who has been one of my PhD students' co-supervisors and from whom I learned particularly the methods of and cultivated a passion for supervision;
- Prof. Tongxi Yu and Prof. Jinguang Teng, who collaborated with me in the complex deformation of fabrics, including drape and wrinkle simulation.

Sections of the following articles have been included in this book and I wish to thank Dr Ludwig Rebenfeld, editor of the *Textile Research Journal*, for allowing us to include them here:

1. Bending hysteresis of plain woven fabrics in various directions, no. 70, pp. 237–242, March 2000.
2. Modeling the creasing properties of woven fabrics, no. 70, pp. 247–255, March 2000.
3. Bending behavior of woven fabrics with vertical seams, no. 70, pp. 148–153, February 2000.
4. The KES shear test for fabrics, no. 67, pp. 654–664, September 1997.
5. Shear properties of woven fabrics in various directions, no. 72, pp. 383–390, May 2002.
6. Modeling a fabric drape profile, no. 72, pp. 454–463, May 2002.
7. Numerical drape behavior of circular fabric sheets over circular pedestals, no. 70, pp. 593–603, July 2000.
8. Drape behavior of woven fabrics with seams, no. 68, pp. 913–919, December 1998.

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Dr Jinlian HU