

# Contents

<b>Chapter 1: Introduction</b>	<b>1</b>
Introductory comments	1
Physics and mathematics	2
Mathematics – a brief review	2
Exercises	6
<b>Chapter 2: Ultrasound interaction with tissue</b>	<b>7</b>
Ultrasound waves and propagation	7
Attenuation	9
Reflection and scattering	11
Refraction	14
<b>Chapter 3: Pulsed ultrasound and imaging</b>	<b>17</b>
Pulsed ultrasound	17
Pulse echo principle	19
Principles of image formation	22
<b>Chapter 4: Transducers</b>	<b>25</b>
Transducer principles	25
Focussing	27
Array transducers	32
Beams, image quality and artifacts	37
<b>Chapter 5: Ultrasound instrumentation</b>	<b>41</b>
Introductory comments	41
The machine's front end	41
Signal processing	43
Image processing	48
<b>Chapter 6: Image artifacts</b>	<b>53</b>
Introductory comments	53
Imaging assumptions	53
Attenuation artifacts	54
Depth artifacts	57
Beam dimension artifacts	60
Beam path artifacts	65
Equipment and electrical artifacts	68
<b>Chapter 7: Doppler ultrasound</b>	<b>71</b>
The Doppler effect and its applications in ultrasound	71
Continuous wave (CW) Doppler	76

Pulsed Doppler	78
Spectral display	80
Colour Doppler	82
<b>Chapter 8: Doppler artifacts</b>	<b>89</b>
Spectral Doppler artifacts	89
Colour Doppler artifacts	97
<b>Chapter 9: Haemodynamic concepts</b>	<b>101</b>
Cardiovascular system	101
Blood flow and blood pressure	101
Stenotic disease	102
Velocity waveform	103
Velocity profile	105
Venous disease	107
<b>Chapter 10: Chapter 10: Equipment performance</b>	<b>109</b>
Introductory comments	109
Spatial resolution	109
Contrast resolution	111
Temporal resolution	111
Assessing equipment performance	113
<b>Chapter 11: Bioeffects and safety</b>	<b>117</b>
Is ultrasound safe?	117
Mechanisms	118
Characterising ultrasound exposure	121
Government regulation	123
Policies and statements	124
<b>Chapter 12: Additional modes and capabilities</b>	<b>127</b>
Introductory comments	127
Compound imaging	127
Harmonics	130
Ultrasound contrast agents	135
3D and 4D ultrasound	136
Extended field of view	139
Image optimisation	140
Image manipulation	140
Elastography	140
Summary	140
<b>Answers to exercises</b>	<b>143</b>
<b>Index</b>	<b>144</b>