

- **I Basic Clinical Measurements**
- **1 Measuring Body Temperature (p. 1)**
- **1.1 Introduction (p. 1)**
- **1.2 Noninvasive Sites for T_c Measurements (p. 4)**
- **1.3 Invasive Sites for T_c Measurements (p. 5)**
- **1.4 Methods and Instruments for T_c Measurement (p. 6)**
- **1.5 Summary (p. 9)**
- **References (p. 9)**
- **2 Ultrasonic Blood Flow and Velocity Measurement (p. 1)**
- **2.1 Introduction (p. 1)**
- **2.2 Ultrasound Physics (p. 1)**
- **2.3 Ultrasonic Transducers (p. 2)**
- **2.4 Transit-Time Dimension (p. 2)**
- **2.5 Transit-Time Velocity and Flow (p. 4)**
- **2.6 Doppler Velocity (p. 6)**
- **2.7 Continuous Wave Doppler (p. 6)**
- **2.8 Pulsed Doppler Velocity (p. 7)**
- **2.9 Doppler Signal Processing (p. 8)**
- **2.10 Multigate and Color Doppler (p. 10)**
- **2.11 Feature Extraction (p. 11)**
- **2.12 Converting Velocity to Volume Flow (p. 12)**
- **2.13 Other Applications of Doppler Velocimetry (p. 13)**
- **2.14 Artifacts and Limitations (p. 13)**
- **2.15 Summary (p. 15)**
- **References (p. 15)**
- **3 Electromagnetic Blood Flow Measurements (p. 1)**
- **3.1 Introduction (p. 1)**
- **3.2 Methodology and Instrumentation (p. 2)**
- **3.3 Discussion (p. 14)**
- **References (p. 17)**
- **4 Electromyography: Detection, Processing, and Applications (p. 1)**
- **4.1 Introduction (p. 1)**
- **4.2 EMG Signal Generation and Detection (p. 2)**
- **4.3 EMG Signal Processing (p. 36)**
- **4.4 Applications of EMG in Basic Research and Clinical Routine (p. 49)**
- **4.5 Conclusion (p. 60)**
- **Acknowledgments (p. 60)**
- **References (p. 60)**
- **5 Evoked Potentials (p. 1)**
- **5.1 Basic Operational Mechanisms (p. 1)**
- **5.2 Signal Processing (p. 6)**
- **5.3 Detecting of Malfunctions (p. 15)**
- **References (p. 17)**
- **Additional Recommendations and Standards (p. 17)**
- **6 Electroencephalography (p. 1)**
- **6.1 Basic Operational Mechanisms (p. 1)**

- **6.2 Signal Processing** (p. 6)
- **6.3 Detecting Malfunctions** (p. 18)
- **References** (p. 20)
- **Additional Recommendations, Standards, and Further Reading** (p. 20)
- **7 Hearing and Audiologic Assessment** (p. 1)
- **7.1 Structure of the Auditory System** (p. 2)
- **7.2 Sound and the Decibel** (p. 9)
- **7.3 Assessing the Auditory System** (p. 11)
- **7.4 Degree of Loss** (p. 15)
- **7.5 Speech Reception Threshold** (p. 15)
- **7.6 Speech Recognition Testing** (p. 16)
- **7.7 Otoacoustic Emissions** (p. 17)
- **7.8 Spontaneous Otoacoustic Emissions (SOAE)** (p. 17)
- **7.9 Transient-Evoked Otoacoustic Emissions** (p. 17)
- **7.10 Distortion Product Otoacoustic Emissions** (p. 19)
- **7.11 Stimulus Frequency Otoacoustic Emissions** (p. 20)
- **7.12 Immittance Audiometry** (p. 20)
- **7.13 Acoustic Reflex** (p. 22)
- **7.14 Common Pathologic Conditions of the Auditory System** (p. 23)
- **7.15 Sensory-Neural Loss** (p. 25)
- **7.16 Central Disorders** (p. 27)
- **7.17 Amplification** (p. 27)
- **References** (p. 28)
- **II Imaging Techniques**
- **8 Magnetic Resonance Imaging** (p. 1)
- **8.1 Introduction** (p. 1)
- **8.2 Hardware Components of an MRI Scanner** (p. 2)
- **8.3 Image Encoding** (p. 3)
- **8.4 Endogenous Tissue Contrast** (p. 5)
- **8.5 Contrast Agents** (p. 10)
- **8.6 fMRI** (p. 13)
- **8.7 Magnetic Resonance Angiography and Flow Quantification** (p. 14)
- **8.8 MR Spectroscopy (MRS) and Spectroscopic Imaging (MRSI)** (p. 23)
- **8.9 MR Evaluation of Cardiac Function: An Example of an Integrated MRI Exam** (p. 24)
- **8.10 Conclusion** (p. 26)
- **Suggested Further Reading** (p. 27)
- **9 Ultrasonic Imaging** (p. 1)
- **9.1 Fundamentals of Ultrasound** (p. 1)
- **9.2 Transducers** (p. 7)
- **9.3 Ultrasound Fields** (p. 10)
- **9.4 Ultrasonic Imaging** (p. 16)
- **9.5 Current Developments** (p. 23)
- **References** (p. 30)
- **10 Emission Imaging: SPECT and PET** (p. 1)
- **10.1 Introduction** (p. 1)

- **10.2 Radioisotopes** (p. 2)
- **10.3 Radiopharmaceuticals** (p. 8)
- **10.4 Instrumentation for Emission Imaging** (p. 28)
- **Acknowledgment** (p. 46)
- **References** (p. 46)
- **11 Endoscopy** (p. 1)
- **11.1 Introduction** (p. 1)
- **11.2 Basic Components of an Endoscope** (p. 2)
- **11.3 Endoscopic Imaging** (p. 5)
- **11.4 Endoscopic Image Formation** (p. 8)
- **11.5 Endoscopic Image Resolution** (p. 11)
- **11.6 Endoscopic Image Signal-to-Noise Ratio** (p. 12)
- **11.7 Color Image Processing** (p. 13)
- **11.8 Endoscopic Retrograde Cholangiopancreatography** (p. 15)
- **11.9 Endoscopic Ultrasound** (p. 16)
- **11.10 Optical Coherence Tomography** (p. 17)
- **11.11 High Magnification Endoscopy** (p. 19)
- **11.12 Chromoendoscopy** (p. 20)
- **11.13 Fluorescence Imaging** (p. 20)
- **11.14 Wireless Capsule** (p. 23)
- **11.15 Virtual Endoscopy** (p. 24)
- **11.16 Summary and Conclusions** (p. 25)
- **References** (p. 26)
- **12 Functional Brain Mapping Using Intracranial Source Imaging** (p. 1)
- **12.1 Introduction** (p. 1)
- **12.2 Neurophysiological Signals** (p. 2)
- **12.3 Mathematical Modeling** (p. 3)
- **12.4 Neurophysiological Recordings** (p. 5)
- **12.5 Data Analysis** (p. 8)
- **12.6 Application Examples** (p. 10)
- **12.7 Concluding Remarks** (p. 13)
- **References** (p. 15)
- **III Biological Assays**
- **13 Molecular Biology Techniques and Applications** (p. 1)
- **13.1 Introduction** (p. 1)
- **13.2 Isolation of Nucleic Acids** (p. 2)
- **13.3 Analysis of Nucleic Acid** (p. 3)
- **13.4 Applications** (p. 10)
- **Acknowledgments** (p. 18)
- **References** (p. 19)
- **14 Theoretical Considerations for the Efficient Design of DNA Arrays** (p. 1)
- **14.1 Introduction** (p. 1)
- **14.2 Surface Design** (p. 1)
- **14.3 DNA Biosensors** (p. 6)
- **14.4 Conclusions** (p. 12)
- **Acknowledgments** (p. 12)

- **References** (p. 12)
- **15 Biological Assays: Cellular Level** (p. 1)
- **15.1 Introduction** (p. 1)
- **15.2 Cell Culture** (p. 1)
- **15.3 General Microscopy Principles** (p. 9)
- **15.4 Flow Cytometry** (p. 15)
- **15.5 Molecular Biology** (p. 18)
- **15.6 Conclusions** (p. 27)
- **Acknowledgments** (p. 27)
- **References** (p. 28)
- **16 Histology and Staining** (p. 1)
- **16.1 Introduction** (p. 1)
- **16.2 Fixation** (p. 3)
- **16.3 Tissue Processing** (p. 5)
- **16.4 Cutting** (p. 7)
- **16.5 Staining** (p. 10)
- **16.6 Mounting** (p. 17)
- **16.7 Microscopy** (p. 18)
- **References** (p. 21)
- **17 Radioimmunoassay: Technical Background** (p. 1)
- **17.1 Introduction** (p. 1)
- **17.2 Principle** (p. 1)
- **17.3 Radioimmunoassay Techniques** (p. 3)
- **17.4 Validation of a Radioimmunoassay Procedure** (p. 6)
- **17.5 Applications** (p. 7)
- **References** (p. 9)
- **IV Genetic and Tissue Engineering**
- **18 Genetic Engineering of Animals** (p. 1)
- **18.1 Introduction** (p. 1)
- **18.2 Production of Transgenic Animals** (p. 4)
- **18.3 Evolving Technologies** (p. 8)
- **18.4 Conclusions and Future Directions** (p. 9)
- **Acknowledgments** (p. 10)
- **References** (p. 10)
- **19 Gene-Enhanced Tissue Engineering** (p. 1)
- **19.1 Introduction** (p. 1)
- **19.2 Gene Therapeutics** (p. 2)
- **19.3 Genetic Modification for Tissue Engineering** (p. 7)
- **19.4 Challenges Facing Gene Delivery** (p. 12)
- **19.5 Summary** (p. 16)
- **References** (p. 17)
- **20 Shear Stress and Chondrocytes** (p. 1)
- **20.1 Introduction** (p. 1)
- **20.2 Chondrocytes and Cell Adhesion** (p. 2)
- **20.3 Mechanical Property Measurement of Single Cells** (p. 6)
- **20.4 Effect of Shear Stress on Chondrocytes** (p. 8)

- **20.5 Conclusions** (p. 12)
- **Acknowledgments** (p. 13)
- **References** (p. 13)
- **21 Bioactive Scaffold Design for Articular Cartilage Engineering** (p. 1)
- **21.1 Introduction** (p. 1)
- **21.2 Scaffold Materials** (p. 2)
- **21.3 Surface Modification** (p. 8)
- **21.4 Growth Factor Inclusion** (p. 11)
- **21.5 Conclusion** (p. 11)
- **Acknowledgment** (p. 12)
- **References** (p. 12)
- **V Interventional Disease Treatment**
- **22 Anesthesia/Monitoring Devices** (p. 1)
- **22.1 Technical Background** (p. 1)
- **22.2 Signal Processing** (p. 8)
- **References** (p. 8)
- **23 Intraoperative Neurophysiological Monitoring** (p. 1)
- **23.1 Introduction** (p. 1)
- **23.2 Overview** (p. 1)
- **23.3 Neurophysiological Recordings: Spontaneous Activity** (p. 4)
- **23.4 Neurophysiological Recordings: Evoked Potentials** (p. 6)
- **23.5 Application Examples** (p. 8)
- **23.6 Conclusions** (p. 10)
- **References** (p. 10)
- **24 Technical Considerations in the Construction of Vascular Anastomoses** (p. 1)
- **24.1 Introduction** (p. 1)
- **24.2 Materials** (p. 2)
- **24.3 Anastomoses** (p. 3)
- **24.4 Surgical Applications** (p. 3)
- **24.5 Patency** (p. 6)
- **References** (p. 17)
- **25 Minimally Invasive Cardiovascular Technologies** (p. 1)
- **25.1 Introduction** (p. 1)
- **25.2 Angioplasty** (p. 2)
- **25.3 Stents** (p. 4)
- **25.4 Aneurysm Treatment** (p. 9)
- **25.5 Embolic Filters** (p. 11)
- **25.6 Cardiac Ablation Catheters** (p. 13)
- **References** (p. 13)
- **26 Stereotactic Procedures** (p. 1)
- **26.1 Introduction** (p. 1)
- **26.2 Methods** (p. 1)
- **26.3 Clinical Applications** (p. 3)
- **26.4 Complications** (p. 5)
- **26.5 New Directions** (p. 5)
- **26.6 Discussion** (p. 6)

- **References** (p. 6)
- **VI Ambulatory Adaptations**
- **27 Ambulatory Applications for Monitoring Physiological Parameters** (p. 1)
- **27.1 Introduction** (p. 1)
- **27.2 Systems Approach to Ambulatory Applications** (p. 3)
- **27.3 Integrated Physiological Data Recorders** (p. 18)
- **References** (p. 22)
- **Bibliography** (p. 23)
- **VII Recovery**
- **28 Neural Prostheses for Movement Restoration** (p. 1)
- **28.1 Introduction** (p. 1)
- **28.2 Skeletal Muscles--Movement Actuators** (p. 2)
- **28.3 Functional Electrical Stimulation Principles** (p. 9)
- **28.4 Instrumentation for FES** (p. 13)
- **28.5 Neural Prostheses for Restoring Upper and Lower Extremity Functions** (p. 29)
- **References** (p. 40)
- **29 Pharmaceutical Technical Background on Delivery Methods** (p. 1)
- **29.1 Introduction** (p. 1)
- **29.2 Central Nervous System: Drug Delivery** (p. 2)
- **29.3 Cardiovascular System: Drug Delivery** (p. 4)
- **29.4 Orthopedic: Drug Delivery** (p. 6)
- **29.5 Muscular System: Drug Delivery** (p. 8)
- **29.6 Sensory: Drug Delivery** (p. 9)
- **29.7 Digestive System: Drug Delivery** (p. 10)
- **29.8 Pulmonary: Drug Delivery** (p. 11)
- **29.9 Ear, Nose, and Throat: Drug Delivery** (p. 13)
- **29.10 Lymphatic System: Drug Delivery** (p. 15)
- **29.11 Reproductive System: Drug Delivery** (p. 16)
- **References** (p. 17)
- **VIII Alternative and Emerging Techniques**
- **30 Hyperbaric Oxygen Therapy** (p. 1)
- **30.1 Introduction** (p. 1)
- **30.2 Indications and Outcomes for Hyperbaric Oxygen Treatment** (p. 2)
- **30.3 Summary** (p. 8)
- **References** (p. 8)
- **31 Image-Guided Thermal Therapy** (p. 1)
- **31.1 Introduction** (p. 1)
- **31.2 Thermal Therapy** (p. 2)
- **31.3 Image-Guided Thermal Therapy** (p. 6)
- **31.4 Delivery Strategies for Image-Guided Thermal Therapy** (p. 10)
- **31.5 Conclusions** (p. 20)
- **References** (p. 21)
- **32 Medical Robotics** (p. 1)
- **32.1 Introduction** (p. 1)
- **32.2 Robotic Review** (p. 1)
- **32.3 Medical Robotics History** (p. 2)

- **32.4 Clinical Applications** (p. 3)
- **32.5 Technology Challenges/Research Areas** (p. 21)
- **32.6 Conclusions** (p. 24)
- **Acknowledgments** (p. 24)
- **References** (p. 24)
- **Index** (p. 1)