Contents

1 Introduction and historical notes **1**

2 Biophysical fundamentals **3**
2.1 Blood circulation systems 3
2.2 Optical properties of biological tissues 4
2.3 Light distribution in biological tissues 6
2.4 Measuring range and sensitivity of PPG sensors 8
2.5 Synthesis of the PPG signal: venous and arterial part 9

3 Automatic calibration procedure in quantitative photoplethysmography **11**
3.1 Calibration procedure 11
3.2 Advantages of calibrated PPG 13
3.3 Quantitative photoplethysmographs on the market 14

4 Photoplethysmographic tests **19**
4.1 Photoplethysmographic muscle pump tests 21
4.1.1 Standard form of the D–PPG examination record . . . 24
4.1.2 Tourniquet test before surgery 25
4.1.3 Therapy follow-up with D–PPG 26
4.1.4 First quantitative on–line recordings with D–PPG . . . 27
4.1.5 Evaluation of muscle pump efficiency with D–PPG . . 28
4.1.6 Two–channel muscle pump test 29
4.1.7 Two dimensional description of T_o and V_o 30
4.1.8 T_o and V_o in relation to clinical severity of CVI 31
4.1.9 Special D–PPG examinations 32
4.2 Photoplethysmographic vein occlusion test (VOT) 35
4.2.1 Automatic measurement procedure by OVP 37
4.2.2 Definition of functional evaluation parameters 38
4.2.3 Standard form of the OVP examination record 39
4.2.4 Two–channel vein occlusion test 40
4.2.5 Two dimensional description of VO and VC 41
4.2.6 OVP databank 42
4.2.7 General medical guidance on VOT measurements . . . 43
4.2.8 Average time required for OVP testing 44

4.3 Comparison of PPG and invasive vein pressure measurements (VPM) 45
4.4 Photoplethysmographic vein pressure test 48
4.4.1 Examination method 49
4.4.2 Preliminary vein pressure test results 50
4.5 Photoplethysmographic tests for arterial diagnostics 52
4.5.1 Registrations of pulsatile peripheral waveforms in the time and frequency domain 54
4.5.2 Application example: Long time perfusion measurements 57
4.5.3 Application example: Segmental blood pressure measurements 58
4.5.4 Systems in comparison: Commercial MBO blood pressure monitor versus A–PPG prototype 59
4.5.5 Audio–Photoplethysmography 60

5 Final remarks **63**

References **65**