

# Contents

## Part I Informatics in medicine

<b>1</b>	<b>Approach for spectrogram analysis in detection of selected pronunciation pathologies</b>	<b>3</b>
	Wojciech Bodusz, Zuzanna Miodońska and Paweł Badura	
1.1	Introduction	3
1.2	Materials and methods	4
1.2.1	Preprocessing	5
1.2.2	Image processing and extraction of image features	6
1.2.3	Classification	9
1.2.4	Validation	9
1.3	Results and discussion	9
1.3.1	Experimental results	9
1.3.2	Discussion	10
1.4	Conclusion	10
	References	11
<b>2</b>	<b>Automatic segmentation of lung cancer cells with the new parameters by using methods of image processing and analysis.</b>	<b>13</b>
	Przemysław Jędrusik, Robert Koprowski, Ilona Bednarek and Zygmunt Wróbel	
2.1	Introduction	13
2.2	Materials in experiment	14
2.3	Methods	15
2.4	Results	17
2.5	Discussion	19
2.6	Conclusions	20
	References	20

<b>3</b>	<b>Breast Cancer Segmentation Method in Ultrasound Images</b>	<b>23</b>
	Marta Galińska, Weronika Ogiegło, Agata Wijata, Jan Juszczuk and Joanna Czajkowska	
3.1	Introduction	23
3.2	Materials and Methods	25
3.3	Results and Discussion	27
3.4	Conclusion	28
	References	30
<b>4</b>	<b>Detection and Tracking of the Biopsy Needle Using Ultrasound Images</b>	<b>33</b>
	Agata Wijata, Żaneta Ranoosz, Marta Galińska, Jan Juszczuk and Joanna Czajkowska	
4.1	Introduction	33
4.2	Materials and Methods	35
4.2.1	Materials	35
4.2.2	Methods	35
4.3	Results and Discussion	39
4.4	Conclusion	40
	References	40
<b>5</b>	<b>Detection of Wet Age-related Macular Degeneration in OCT Images: A Case Study</b>	<b>43</b>
	Anam Haq and Szymon Wilk	
5.1	Introduction	43
5.2	Related Work	44
5.3	Methods	45
5.3.1	Preprocessing	45
5.3.2	Segmentation	46
5.3.3	Feature Extraction	47
5.3.4	Construction of Classifiers	47
5.4	Results and Discussion	47
5.5	Conclusion	50
	References	50
<b>6</b>	<b>Gender recognition using artificial neural networks and data coming from force plates</b>	<b>53</b>
	Jakub Krzysztof Grabski, Tomasz Walczak, Martyna Michałowska, and Magdalena Cieślak	
6.1	Introduction	53
6.2	Human gait and ground reaction forces	54
6.3	Data from the force plates	56
6.4	Artificial neural network	57
6.5	Results	57
6.6	Summary	59
	References	59

<b>7</b>	<b>Human Sperm Morphology Analysis using a Digital Holographic Microscope</b>	<b>61</b>
	Emil Fabian, Marzena Kamieniczna, Maciej Kurpisz and Ewa Stachowska	
7.1	Introduction	61
7.2	Materials and apparatus	62
7.3	Method	64
7.4	Measurements and results	65
7.5	Conclusions	67
	References	67
<b>8</b>	<b>Idea and measurement methods used in bioimpedance spectroscopy.</b>	<b>69</b>
	Barbara Szuster, Zbigniew Szczurek, Dawid Roj, Pawel Kowalski, Aleksander Sobotnicki and Jakub Woloszyn	
8.1	Introduction	69
8.2	Impedance measurements - physical basis	70
8.3	Electrical bioimpedance	71
8.4	Body impedance device developed at ITAM	72
8.5	Comparison of different commercially available devices for bioimpedance measurements	73
8.6	Different methods for the measurement and analysis of body composition	76
	8.6.1 DXA	76
	8.6.2 Antropometric measurements	77
	8.6.3 Analysis of neuronal activation	77
8.7	Conclusion	77
	References	78
<b>9</b>	<b>Prototype measurement system for spatial analysis of speech signal for speech therapy</b>	<b>79</b>
	Kinga Kostera, Wojciech Więclawek, and Michał Kręcichwost	
9.1	Introduction	79
9.2	Materials and methods	80
	9.2.1 Database	80
	9.2.2 Measuring system	80
	9.2.3 Signal processing	81
9.3	Experiments and results	82
	9.3.1 Distance from sound source to microphone array	82
	9.3.2 Influence of recorded signals frequency	84
9.4	Discussion	84
9.5	Conclusion	85
	References	86

<b>10</b>	<b>Shear Wave Elastography and Strain Elastography: a Study on a Phantom</b>	87
	Bartłomiej Pyciński, Jan Juszczyk, and Rafał Obuchowicz	
10.1	Introduction	87
10.2	Materials and methods	88
10.2.1	US phantom	88
10.3	Experiments and results	90
10.3.1	Shear Wave Elasticity Imaging	90
10.3.2	Strain Elastography	92
10.3.3	Phantom ultrasound velocity	94
10.4	Conclusion	95
	References	95
<b>11</b>	<b>A simple setup for repeatability analysis of a low-level laser therapy scanner</b>	97
	Dawid Kucharski and Jagoda Nowak	
11.1	Introduction	97
11.2	Experimental Setup	98
11.2.1	The Polaris 2 scanner	98
11.2.2	Detection	99
11.3	Results	101
11.3.1	The speed of the beam	101
11.3.2	Laser beam geometry	103
11.4	Summary	104
	References	104
<b>12</b>	<b>The influence of music genres on human emotionality</b>	107
	Monika N. Bugdol, Marcin D. Bugdol and Tomasz Smreczak	
12.1	Introduction	107
12.2	Materials and methods	108
12.3	Results	109
12.4	Discussion	113
	References	114

## Part II Signal analysis

<b>13</b>	<b>2017 Monitoring and Teletransmission of Medical-Data in Heart Failure. First Report</b>	117
	Mateusz Tajstra, Piotr Rozentryt, Elżbieta Gadula-Gacek, Jacek Niedziela, Elżbieta Adamowicz-Czoch, Aneta Ociessa, Adam Gacek, Arkadiusz Gwóźdź, Marcin Wilczek, Aleksander Płaczek, Konrad Wojciechowski, Adam Sokal, Zbigniew Kalarus, Mariusz Gąsior, and Lech Poloński	
13.1	Introduction	118
13.2	Materials and Methods	119
13.2.1	Information Platform for Integrated Data Collection	119

13.2.2	EXTRABIOTEL-HF study	120
13.3	Results	120
13.4	Conclusions	120
	References	123
<b>14</b>	<b>Application of Discrete Cosine Transform for Pre-Filtering Signals in Electrogastrography</b>	<b>125</b>
	Dariusz Komorowski and Barbara Mika	
14.1	Introduction	125
14.2	Methods	127
14.3	Results	128
14.4	Discussion and Conclusions	131
	References	132
<b>15</b>	<b>Determining Heart Rate Beat-to-Beat from Smartphone Seismocardiograms: Preliminary Studies</b>	<b>133</b>
	Szymon Sieciński and Paweł Kostka	
15.1	Introduction	133
15.2	Methods	135
15.2.1	Experiment protocol	135
15.2.2	HRV Estimation Algorithm	135
15.2.3	Signal Processing	136
15.3	Results	136
15.4	Discussion	139
	References	139
<b>16</b>	<b>Field modelling of several electromagnetic drive variants of the micropump blood transfusion device</b>	<b>141</b>
	Sebastian Bartel, Zbigniew Pilch and Tomasz Trąwinski	
16.1	Introduction	141
16.2	Trends in developing ventricular assist devices and total artificial hearts	142
16.3	Geometrical modelling of electromagnetic pulsatile artificial heart	144
16.4	Conclusions	147
	References	148
<b>17</b>	<b>Minimizing interference from cardiac stimulator pulse in the ECG recordings during the diagnostics of myocardial ischemia by non-invasive transcutaneous cardiac stimulation</b>	<b>151</b>
	Jerzy Gałęcka, Fryderyk Prochaczek, Adam Gacek and Hanna Winiarska-Prochaczek	
17.1	Introduction	151
17.2	Sources of interference	153
17.3	Methods of interference suppression	154
17.4	Minimizing interference in the precordial leads	157
17.5	Summary	159
	References	160

<b>18</b>	<b>Novel tumor protein markers collection by the use of highly porous organic material for the upper and lower respiratory system – preliminary results</b>	161
	Andrzej S. Swinarew, Barbara Mika, Jarosław Paluch Jadwiga Gabor, Marta Łęźniak, Hubert Okła, Tomasz Flak, Beata Swinarew, and Klaudia Kubik	
18.1	Introduction	162
18.2	Methods	164
18.2.1	Synthesis of sorbent material	164
18.2.2	MALDI-TOF analysis	165
18.3	Results and discussion	165
18.4	Conclusions	167
	References	168
<b>19</b>	<b>Statistical Analysis of the Impact of Molecular Descriptors on Antimicrobial Activity of Thiourea Derivatives Incorporating 3-amino-1,2,4-triazole Scaffold</b>	171
	Anna Filipowska, Wojciech Filipowski, Ewaryst Tkacz, and Monika Wujec	
19.1	Introduction	171
19.2	Experimental Works and Methods	172
19.3	Results	175
19.4	Conclusions	181
	References	183
<b>20</b>	<b>The Face Tracking System for Rehabilitation Robotics Applications</b>	185
	Paweł Raif and Ewaryst Tkacz	
20.1	Introduction	185
20.2	Methods	186
20.2.1	Hardware	186
20.2.2	Software	187
20.2.3	Connections	187
20.2.4	Camera Control	188
20.2.5	Vision analysis and face tracing task	188
20.3	Results	190
20.4	Conclusions and future work	191
	References	191
<b>21</b>	<b>The higher-order spectra as a tool for the identification of patients diagnosed with various cardiac diseases</b>	193
	Zbigniew Budzianowski, Ewaryst Tkacz, Wojciech Oleksy, Małgorzata Garbacik	
21.1	Introduction	193
21.2	Material and Methods	194
21.2.1	A description of the data used	194
21.2.2	Signal processing	194
21.3	Calculation	194

21.4	Results	195
21.4.1	Bispectral analyses	196
21.4.2	Bicohrent analyses	199
21.4.3	Discussion	202
21.4.4	Conclusions	202
21.5	List of Abbreviations	203
	References	203
<b>22</b>	<b>The prototype of wearable sensors system for supervision of patient rehabilitation using artificial intelligence methods</b>	<b>205</b>
	Eliasz Kańtoch, Dominik Grochala, Marcin Kajor, and Dariusz Kucharski	
22.1	Introduction	205
22.2	Architecture of the developed prototype	207
22.2.1	System hardware	207
22.2.2	Multi-sensor acquisition unit	207
22.2.3	ECG acquisition	208
22.3	Experimental setup	209
22.4	Methods	210
22.4.1	4.1 Dataset preparation and processing	210
22.4.2	4.2 Classification with machine learning algorithms.	211
22.5	Results and discussion	212
22.6	Acknowledgment	214
	References	214
<b>Part III Modelling and simulations in biomechanics</b>		
<b>23</b>	<b>Assessment of balance of older people living at a social welfare home</b>	<b>217</b>
	Katarzyna Jochymczyk-Woźniak, Katarzyna Nowakowska, Robert Michnik, Agnieszka Nawrat-Szołtysik and Wioletta Górka	
23.1	Introduction	217
23.2	Methods	218
23.3	Results and Discussion	219
23.4	Conclusion	223
	References	223
<b>24</b>	<b>Assessment of locomotor functions of patients suffering from cerebral palsy qualified to treat by different methods</b>	<b>225</b>
	Katarzyna Jochymczyk-Woźniak, Katarzyna Nowakowska, Robert Michnik, Agnieszka Konopelska, Jerzy Luszawski and Marek Mandera	
24.1	Introduction	225
24.2	Materials and Methods	227
24.3	Results	229
24.4	Discussion	229
24.5	Conclusion	231
	References	232

<b>25</b>	<b>Body part accelerations evaluation for chosen techniques in martial arts</b>	235
	Sebastian Glowiński, Andrzej Błażejowski and Tomasz Krzyżyński	
25.1	Introduction	235
25.2	Ukemi	236
25.2.1	Koho Ukemi	236
25.2.2	Yoko Ukemi	237
25.2.3	Mae Ukemi	237
25.2.4	Zenpo Kaiten Ukemi	238
25.3	Materials and Methods	239
25.3.1	Participant	239
25.3.2	Wireless sensing system	239
25.3.3	Experiment procedure	240
25.4	Results	240
25.5	Discussion	242
	References	243
<b>26</b>	<b>Determination of the number and frequency of the steps for gait with elbow crutches based on a crutch acceleration</b>	245
	Magdalena Długosz, Piotr Wodarski, Andrzej Bieniek, Miłosz Chrzan, Marek Gzik, Kamil Jozsko and Jarosław Derejczyk	
26.1	Introduction	245
26.2	Methodology	247
26.3	Results	248
26.4	Discussion	250
26.5	Conclusions	252
	References	252
<b>27</b>	<b>Factors influencing on mechanical properties of porcine skin obtained in tensile test-preliminary studies</b>	255
	Aneta Liber-Kneć and Sylwia Łagan	
27.1	Intoduction	255
27.2	Material and Methodology	256
27.3	Results and Discussion	257
27.4	Conclusions	261
	References	261
<b>28</b>	<b>Flow of subretinal liquid through the retinal hole after surgery – mechanical model and FEM simulations</b>	263
	Tomasz Walczak, Paweł Fritzkowski, Marcin Stopa, and Martyna Michałowska	
28.1	Introduction	263
28.2	Numerical simulations	264
28.3	Remarks	269
	References	270



<b>29</b>	<b>Impact of Vessel Mechanical Properties on Hemodynamic Parameters of Blood Flow</b>	271
	Wojciech Wolański, Bożena Gzik-Zroska, Kamil Jozsko, Edyta Kawlewska, Marta Sobkowiak, Marek Gzik and Wojciech Kaspera	
29.1	Introduction	272
29.2	Methods	272
29.3	Results	274
29.4	Discussion and Conclusions	277
	References	278
<b>30</b>	<b>Influence of strain rates on the hyperelastic material models parameters of pig skin tissue</b>	279
	Sylvia Łagan and Aneta Liber-Kñec	
30.1	Intoduction	279
30.2	Material and Methodology	280
30.3	Results and Discusion	281
30.4	Conclusions	286
	References	286
<b>31</b>	<b>Methodology of multicriterial optimization of geometric features of an orthopedic implant</b>	289
	Małgorzata Muzalewska and Wojciech Moczulski	
31.1	Origin of work	289
31.1.1	Multicriterial optimization	290
31.1.2	Immune algorithms	291
31.2	Methodology of the optimal selection of geometric features of an orthopedic implant	291
31.2.1	Design assumptions	291
31.2.2	Criteria of concept evaluation - Strength	292
31.2.3	Criteria of concept evaluation - blood flow	292
31.2.4	Objective function	292
31.2.5	Pareto Method	293
31.3	Multicriterial optimization method using Immune Algorithm	293
31.4	Verification and validation of the described methodology	294
31.4.1	Optimisation results by using the objective function	294
31.4.2	Simulation results using the Pareto front	295
31.4.3	Strength verification	295
31.5	Conclusion	296
	References	297

<b>32</b>	<b>Research on the stability of the users of chair with a spherical base . .</b>	<b>299</b>
	Robert Michnik, Miłosz Chrzan, Piotr Wodarski, Andrzej Bieniek, Katarzyna Nowakowska, Anita Pollak and Andrzej Mitas	
32.1	Introduction . . . . .	299
32.2	Research methodology . . . . .	301
32.3	Results . . . . .	301
32.4	Discussion . . . . .	304
32.5	Conclusions . . . . .	305
	References . . . . .	306
 <b>Part IV Engineering of biomaterials</b>		
<b>33</b>	<b>Assessment Of Hip Endoprosthesis Cups After Reimplantation . . . . .</b>	<b>311</b>
	Anita Kajzer, Ewelina Głąb, Wojciech Kajzer, Tomasz Wróbel, and Jacek Semenowicz	
33.1	Introduction . . . . .	311
33.2	Materials and Methods . . . . .	312
33.3	Results and discussion . . . . .	314
33.4	Conclusion . . . . .	317
	References . . . . .	317
<b>34</b>	<b>The heat treatment influence on the structure and mechanical properties of Ti6Al4V alloy manufactured by SLM technology . . . . .</b>	<b>319</b>
	Marta Kiel-Jamrozik, Wojciech Jamrozik and Ilona Witkowska	
34.1	Introduction . . . . .	319
34.2	Materials and methods . . . . .	321
34.3	Results . . . . .	322
	34.3.1 Microstructure of Ti6Al4V produced by SLM . . . . .	322
	34.3.2 Results of the mechanical properties of SLM Ti6Al4V . .	323
	34.3.3 Results of roughness measurements of Ti6Al4V alloy fabricated by SLM . . . . .	323
34.4	Discussion . . . . .	325
	References . . . . .	326
<b>35</b>	<b>The Functionalization of Grade 4 Surface Used for Blood Contacting Implants . . . . .</b>	<b>329</b>
	Marcin Basiaga, Magdalena Antonowicz, Witold Walke, Zbigniew Paszenda, and Bogusław Ziębowicz	
35.1	Introduction . . . . .	329
35.2	Materials and Methods . . . . .	330
	35.2.1 Preparation of samples . . . . .	330
	35.2.2 Electrochemical properties . . . . .	331
35.3	Results . . . . .	332
	35.3.1 Electrochemical Properties . . . . .	332
35.4	Conclusions . . . . .	336
	References . . . . .	336

<b>36</b>	<b>The influence of implantation on mechanical degradation of the nanotubular oxide layer on titanium screws</b>	339
	Katarzyna Arkusz	
36.1	Introduction	339
36.2	Experimental details	340
36.2.1	Materials	340
36.2.2	Fabrication of TNT on self-cutting cervical Ti6Al4V ELI screw	341
36.2.3	Electrochemical measurements	341
36.3	Results and discussion	341
36.3.1	Surface morphology of anodized and non-modified Ti6Al4V ELI screws	341
36.3.2	The OCP evaluation of anodized and non-modified Ti6Al4V ELI screws	342
36.3.3	EIS measurements of Ti6Al4V ELI screws	344
36.4	Conclusions	346
	References	346
<b>37</b>	<b>The Influence of Technology on the Physicochemical and Electrochemical Properties of the Prosthetic Materials</b>	349
	Anna Ziębowicz, Anna Woźniak, and Bogusław Ziębowicz	
37.1	Introduction	349
37.2	Material and Method	350
37.2.1	Surface roughness measurements	351
37.2.2	Wettability test	351
37.2.3	Potentiodynamic test	352
37.2.4	Microscope observation	352
37.2.5	EIS test	352
37.3	Results	353
37.3.1	Surface roughness measurements	353
37.3.2	Wettability test	353
37.3.3	Potentiodynamic test	354
37.3.4	Microscope observation	355
37.3.5	EIS tests	355
37.4	Conclusions	356
	References	356
<b>38</b>	<b>Influence of Calcination Temperatures on the Morphology and Specific Surface Area Development of ZrO<sub>2</sub>-CeO<sub>2</sub>-Y<sub>2</sub>O<sub>3</sub>-Al<sub>2</sub>O<sub>3</sub> Powders Obtained via Sol-Gel Route</b>	359
	Damian S. Nakonieczny, Zbigniew K. Paszenda, Justyna Majewska, Sabina Drewniak, Wojciech Bogacz, Magdalena Antonowicz, Agata Sambok, and Cezary Krawczyk	
38.1	Introduction	360
38.2	Materials and Methods	360
38.2.1	Material	360

38.2.2	Methods	361
38.3	Results	361
38.4	Discussion	363
38.5	Conclusion	365
	References	366
<b>39</b>	<b>The method of fretting wear assessment with the application of 3D laser measuring microscope</b>	<b>369</b>
	Jarosław Sidun, Jan Ryszard Dąbrowski	
39.1	Introduction	369
39.2	Research material and methodology	371
39.3	Results	373
39.4	Summary and conclusions	374
	References	376
<b>40</b>	<b>The cell niches reproducing surface structure</b>	<b>379</b>
	Roman Major, Klaudia Trembecka-Wojciga, Jürgen Markus Lackner, and Bogusław Major	
40.1	Introduction	379
40.2	Materials and diagnostic methods	380
40.2.1	Hydrogel coating deposition	380
40.2.2	Surface of modification of the controlled residual stresses	381
40.2.3	In vitro analysis of blood-matreal interaction - Impact-R test	381
40.2.4	Methods of microstructure analysis	383
40.3	Results and discussion	384
40.3.1	Blood-material interaction	385
40.3.2	Endothelialisation	386
40.4	Concluding remarks	387
	References	388
<b>41</b>	<b>Effect Of Sterylization And Long-Term Exposure To Artificial Urine On Corrosion Behaviour Of Metallic Biomaterials With Poly(Glikolide-Co-Kaprolactone) Coatings</b>	<b>391</b>
	Wojciech Kajzer, Joanna Jaworska, Katarzyna Jelonek, Janusz Szewczenko, Katarzyna Nowińska, and Anita Kajzer	
41.1	Introduction	391
41.2	Materials and Methods	392
41.3	Results and discussion	394
41.4	Conclusion	397
	References	398
<b>42</b>	<b>Mechanical characterization of biodegradable materials used in surgery</b>	<b>399</b>
	Angela Andrzejewska	
42.1	Introduction	399

42.2	Materials and methods . . . . .	402
42.2.1	Material . . . . .	402
42.2.2	Mass change . . . . .	402
42.2.3	Mechanical properties . . . . .	402
42.2.4	Statistical analysis . . . . .	403
42.3	Results and Discussion . . . . .	403
42.3.1	Test of mass change . . . . .	403
42.3.2	Test of static properties . . . . .	405
42.3.3	Comparison between mass change and mechanical properties . . . . .	406
42.4	Conclusions . . . . .	407
	References . . . . .	407
	<b>Author Index . . . . .</b>	<b>409</b>

Innovations in Biomedical Engineering

Gzik, M.; Tkacz, E.; Paszenda, Z.; Piętka, E. (Eds.)

2018, XXXIII, 410 p. 210 illus., 130 illus. in color.,

Softcover

ISBN: 978-3-319-70062-5