

## Table of contents

Chapter 1: Introduction .....	1
1.1 Motivation .....	1
1.2 The long way to trunk mechanics .....	1
1.3 Mechanics of trunk motion .....	4
1.3.2 Literature Review .....	5
1.4 Lacking points and hypotheses .....	7
1.4.1 Lacking points and a question .....	7
1.4.2 Formulation of hypotheses .....	8
1.5 Goal and contents of this work .....	10
Chapter 2: Methods and materials .....	11
2.1 Tracking motion .....	11
2.1.1 Different tracking methods .....	11
2.2 Experiments .....	13
2.2.1 Previous studies .....	13
2.2.2 Present examination .....	13
2.2.3 Anthropometry .....	14
2.2.3 Motion Analysis .....	16
2.3 Calculating kinematical data .....	19
2.3.1 First module .....	20
2.3.2 Second module .....	23
2.3.3 Third module .....	36
2.3.4 Fourth module .....	39
Chapter 3: Results kinematics of trunk and head .....	40
3.1 Absolute motions (global frame) .....	40
3.1.1 Pelvis .....	40
3.1.2 Thorax .....	56
3.1.3 Head .....	71
3.2 Relative motions .....	86
3.2.1 Pelvis – thorax .....	86
3.2.2 Thorax – head .....	95
3.3 Anthropometry .....	103
Chapter 4: Interdependencies of trunk motion and anthropometry in humans .....	105
4.1 Introduction .....	105

4.2	Pelvis.....	106
4.2.1	Females .....	106
4.2.2	Males .....	112
4.3	Thorax.....	116
4.3.1	Females .....	116
4.3.2	Males .....	120
4.4	Relative motion pelvis-thorax .....	125
4.4.1	Females .....	125
4.4.2	Males .....	130
Chapter 5: Discussion for chapters 2, 3 and 4.....		138
5.1	Error discussion.....	138
5.2	Discussion.....	142
Chapter 6: Functional morphological model of the trunk in walking humans .....		151
6.1	Anthropomorphic models .....	152
6.1.1	Historical background.....	152
6.2	Functional morphological model of the trunk.....	154
6.2.1	Construction of the segmental body parts.....	155
6.2.2	Artificial ground reaction forces .....	158
6.2.3	Topology of the model.....	162
6.2.4	Methods to assess k & b values.....	166
6.3	Simulation results .....	169
6.3.1	Pelvis .....	169
6.3.2	Abdomen.....	171
6.3.3	Thorax.....	172
6.3.4	Head .....	175
6.3.5	Pelvis-thorax .....	177
6.4	Parameters optimization.....	179
Chapter 7: Applications .....		184
7a	Non-invasive tool for diagnostic of trunk diseases and their rehabilitation control.....	184
7a.1	Diagnostic and rehabilitation control process .....	185
7a.1.1	Motion analyses and anthropometry .....	186
7a.1.2	Kinematical calculations.....	187
7a.1.3	Functional model of the trunk.....	187

7a.1.4	Diagnostic and control tool .....	187
7b	Bionically inspired robots (anthropofunctional machines) .....	189
7b.1	Saving energy and control.....	190
7b.1.1	Using visco-elastic parameters for normal gait.....	190
Chapter 8:	Discussion for chapters 6 and 7.....	193
Chapter 9:	Conclusion .....	198
Appendix A	.....	A- 1 -
A1	Histograms (Females).....	A- 2 -
A2	Histograms (Males): .....	A- 8 -
Bibliography	.....	B- 1 -