

# Contents

<b>Marek Štefan: On Knowledge-based Support for Concurrent Engineering Design</b>	<b>9</b>
<b>Symbols and Abbreviations</b>	<b>9</b>
<b>1 Introduction</b>	<b>13</b>
<b>2 State of the art</b>	<b>15</b>
2.1 Concurrent engineering design . . . . .	15
2.1.1 Introduction and definitions . . . . .	15
2.1.2 Approaches to systematic research of concurrent engineering . . . . .	16
2.1.3 Tools of concurrent engineering . . . . .	17
2.2 Knowledge modelling . . . . .	17
2.2.1 Introduction . . . . .	17
2.2.2 KADS . . . . .	18
2.2.3 Configuration and parametric design task . . . . .	19
2.2.4 Problem solving method . . . . .	21
<b>3 Objectives</b>	<b>25</b>
<b>4 Methods</b>	<b>27</b>
4.1 Sensitivity analysis, original idea . . . . .	27
4.1.1 Basic Notions . . . . .	27
4.1.2 Parameter sensitivity . . . . .	28
4.1.3 Constraint sensitivity . . . . .	29
4.1.4 Locality . . . . .	30
4.1.5 Complexity . . . . .	30
4.2 Sensitivity analysis and problem solving method . . . . .	30
4.2.1 Automatic fix rating . . . . .	31
4.2.2 Local sensitivity matrix . . . . .	34
4.3 Sensitivity analysis and concurrent engineering . . . . .	36
4.3.1 Design process decomposition based on sensitivity . . . . .	36
4.3.2 Global sensitivity matrix . . . . .	41
4.3.3 Functional sensitivity matrix . . . . .	43
<b>5 Results and obtained experience</b>	<b>45</b>
5.1 Benchmarks . . . . .	45
5.2 Automatic fix rating . . . . .	47
5.2.1 Assessment strategy . . . . .	48
5.2.2 Results enunciation . . . . .	49
5.2.3 Results discussion . . . . .	50
5.3 Modified Newton method . . . . .	52

5.4	Knowledge mining and concurrentization experiments . . . . .	55
5.5	Discussion . . . . .	58
5.6	Note on practical aspects of implementation . . . . .	60
<b>6</b>	<b>Consequences for science and technology</b>	<b>61</b>
6.1	Consequences for science . . . . .	61
6.2	Consequences for technology . . . . .	62
6.3	Future research . . . . .	63
<b>7</b>	<b>Conclusions</b>	<b>65</b>
<b>8</b>	<b>Appendices</b>	<b>67</b>
8.1	Traditional Propose&Revise Algorithm . . . . .	67
8.2	Solution of linear systems . . . . .	68
8.2.1	Introduction . . . . .	68
8.2.2	Singular value decomposition for solving the linear systems . . . . .	69
8.3	Modified Newton method . . . . .	71
8.3.1	Mathematical background . . . . .	71
8.3.2	Parametric design interpretation . . . . .	72
8.4	Optimization approach to partitioning . . . . .	73
8.5	Benchmarks—design network details . . . . .	76
8.5.1	Bearing . . . . .	77
8.5.2	VT elevator . . . . .	80
8.5.3	Hydrodynamic pump . . . . .	81

**Miloslav Vilimek: The challenges of musculotendon forces estimation in multiple muscle systems** **83**

<b>1</b>	<b>Anotation</b>	<b>85</b>
<b>2</b>	<b>Introduction</b>	<b>87</b>
<b>3</b>	<b>Specific aims of the study</b>	<b>89</b>
<b>4</b>	<b>Review of literature</b>	<b>91</b>
4.1	Direct measurement of the muscle forces . . . . .	91
4.2	Static and dynamic optimization approach . . . . .	91
4.3	The muscle force estimation by using black-box models . . . . .	93
4.4	Review of the used musculotendon parameters . . . . .	93
<b>5</b>	<b>Musculotendon Dynamics</b>	<b>97</b>
5.1	Functional Properties . . . . .	97
5.2	Contraction Dynamics . . . . .	103
<b>6</b>	<b>Muscle forces calculation about elbow</b>	<b>107</b>
6.1	Experimental data collection and inverse dynamics . . . . .	107
6.2	Static optimization approach . . . . .	108
6.3	EMG-driven models . . . . .	109
6.4	Dynamic optimization approach . . . . .	110
6.5	Results about elbow . . . . .	113

<b>7</b>	<b>Muscle forces estimation about knee</b>	<b>117</b>
7.1	Experimental data collection . . . . .	117
7.2	Static optimization approach . . . . .	118
7.3	EMG-driven methods . . . . .	118
7.4	Results about knee . . . . .	119
<b>8</b>	<b>Neural network in the muscle force prediction</b>	<b>121</b>
8.1	The assembling of the training data . . . . .	121
8.2	The network object and training the network . . . . .	122
8.3	The network sensitivity to the inputs . . . . .	124
8.4	Results . . . . .	125
<b>9</b>	<b>Discussion</b>	<b>127</b>
9.1	The static optimization - the suitable method? . . . . .	128
9.2	Dynamic or static optimization & forward or inverse dynamics . . . . .	128
9.3	What optimization criterion give the best results? . . . . .	129
9.4	The role of the EMG signal in the muscle forces estimation . . . . .	130
9.5	Black-box model and possibility of an artificial neural network in muscle force estimation . . . . .	130
9.6	Limitations, assumptions & future directions . . . . .	131
<b>10</b>	<b>Conclusion</b>	<b>133</b>
<b>11</b>	<b>A tendon slack length estimation</b>	<b>135</b>
<b>Tomáš Mareš: Engineering linear thermoelasticity</b>		<b>139</b>
<b>1</b>	<b>Considered stress–strain relation</b>	<b>141</b>
<b>2</b>	<b>Heat Equation</b>	<b>143</b>
<b>3</b>	<b>Equations of linear thermoelasticity</b>	<b>145</b>
3.1	Compatibility conditions . . . . .	146
3.2	Solution of equations for thermal deformation . . . . .	147
<b>4</b>	<b>Thermal field not producing stress</b>	<b>149</b>
<b>5</b>	<b>The theory of generalized plane thermal stress</b>	<b>151</b>
5.1	Stationary plane axisymmetric thermoelasticity problems . . . . .	155