

Table of contents

Abstract	vi
Zusammenfassung	vii
Table of contents	x
List of figures	xii
List of tables	xiii
List of abbreviations	xvi
1 Introduction	1
2 Sensorimotor control and goal-directed movements	5
2.1 A model of sensorimotor control	5
2.2 Neuroanatomy in sensorimotor control	8
2.3 The sequential processing of goal-directed movements	12
2.4 Brain network dynamics in sensorimotor control	15
3 Measuring network dynamics in sensorimotor control	17
3.1 Choice of method	17
3.2 Electroencephalography - a brief overview	20
3.3 From channel to source space by ICA	24
3.3.1 The principle of ICA	25
3.3.2 Application to the EEG	26
3.3.3 Source localization of equivalent single dipoles	31
3.3.4 Component identification	31
3.3.5 Component clustering	34
3.4 Brain activity measures	34
3.5 Brain connectivity measures	36
3.5.1 Structural connectivity	37
3.5.2 Functional connectivity	37

3.5.3	Effective connectivity	38
3.5.4	Estimating effective connectivity - Application to the EEG	40
4	Applying brain network measures in sports and exercise	45
4.1	Methodological challenges	45
4.1.1	Challenges in data acquisition	46
4.1.2	Suitable movements	48
4.2	Current state of research	49
4.2.1	Measures of brain dynamics in motor precision tasks in controlled settings	49
4.2.2	Measures of complex movements in real-world settings	54
4.3	Summary and Research Deficit	55
5	Research strategy and specific aims	57
6	Methods	61
6.1	Force pulse study	61
6.1.1	Subject characteristics	62
6.1.2	Task setup	63
6.1.3	Task procedure	63
6.1.4	Data acquisition and event processing	65
6.2	Golf putt study	68
6.2.1	Subject characteristics	68
6.2.2	Task setup	69
6.2.3	Task procedure	70
6.2.4	Data acquisition and event processing	72
6.3	Signal processing	74
6.3.1	ICA and ERSP specific processing	76
6.3.2	Effective connectivity and ERC specific processing	80
6.4	Statistical procedures	82
6.4.1	Task performance and psychometric measures	82
6.4.2	EEG data	83
7	Results	85
7.1	Force pulse study	85
7.1.1	Precondition measures	85
7.1.2	Network localization	87
7.1.3	Network activity	92
7.1.4	Network connectivity	94
7.2	Golf putt study	100
7.2.1	Precondition measures	100
7.2.2	Network localization	101
7.2.3	Network activity	104
7.3	Summary	105

8 Discussion	107
8.1 Force pulse study	107
8.1.1 Precondition measures	108
8.1.2 Network localization	109
8.1.3 Network activity	112
8.1.4 Network connectivity	116
8.1.5 Limitations	119
8.1.6 Concluding the specific aims	120
8.2 Golf putt study	122
8.2.1 Precondition measures	123
8.2.2 Network localization	125
8.2.3 Network activity	127
8.2.4 Limitations	128
8.2.5 Concluding the specific aims	129
9 Conclusion	131
10 Prospects	135
10.1 Methodological future work	135
10.2 Towards the application of effective connectivity measures in sports and exercise	138
References	141
Appendix	161
A Major axes of the CNS	161
B Model validation and connectivity estimation	163
B.1 Force pulse study: Model validation results	163
B.2 Force pulse study: Additional ERC results force pulse study . . .	168
C Questionnaires	172
C.1 Anthropometric forms	172
C.2 The Edinburgh-Inventory - German translation	179
C.3 The strait anxiety test X1 (STAI-X1)	181
C.4 Visual Analogue Scale	182
D Spec sheets	183
D.1 Force transducer - Soemer - Load cell 1022	184
D.2 Force transducer - Soemer - digitizing unit LDU 68.1	186
D.3 Accelerometer - Analog Devices - ADXL330	188
D.4 EEG amplifier - Neuroscan - Synamps RT	190
D.5 Channel locations - Neuroscan - QuickCap64	193