

Contents

1	Introduction	3
1.1	Motivation	3
1.2	Context of this thesis	4
1.3	Structure of this thesis	4
2	State of the Art	7
2.1	Characteristics of infrasound	7
2.2	Measurement equipment	8
2.2.1	Measurement microphones	8
2.2.2	Sound level meters	12
2.2.3	Microbarometers	14
2.3	Primary calibration	15
2.4	Secondary calibration	17
2.5	Normative basis	18
3	Primary calibration	21
3.1	Theory	21
3.2	Measurement setup	23
3.2.1	Construction	23
3.2.2	Evaluation	27
3.3	Challenges	29
3.3.1	Background noise	29
3.3.2	Vortex shedding	31
3.3.3	Wind-induced noise	32
3.3.4	Imbalance of the disk	34
3.3.5	Obstacles near the disk	38
3.3.6	Asymmetry of a DUT	39
3.4	Uncertainty analysis	40
3.4.1	Amplitude	40
3.4.2	Phase	45
3.5	Results	48
3.5.1	Comparison to laser pistonphone	48
3.5.2	Project comparison	52
3.5.3	Test of the “ring” wind noise reduction	54
3.6	Discussion	55

4	Secondary calibration	59
4.1	Working principle	59
4.1.1	Comparison principle	59
4.1.2	Excitation with a loudspeaker	62
4.2	Measurement setups	63
4.2.1	Large sound tube	64
4.2.2	Small sound tube	67
4.2.3	Evaluation	68
4.3	Uncertainty analysis	70
4.3.1	Amplitude	70
4.3.2	Phase	72
4.4	Results	73
4.4.1	Characterization of the large sound tube	73
4.4.2	Characterization of the small sound tube	74
4.4.3	Measurement microphones	78
4.4.4	Sound level meters	82
4.4.5	Microbarometer	83
4.4.6	Project comparison	84
4.5	Discussion	86
5	Infrasound measurements in the field	89
5.1	Wind induced noise	90
5.1.1	Introduction	90
5.1.2	Measurement setup and data analysis	91
5.1.3	Results	95
5.1.4	Discussion	99
5.1.5	Conclusion	103
5.2	Defects of the microphone diaphragm	103
5.2.1	Introduction	104
5.2.2	Study of the impact of diaphragm perforation on the frequency response of a microphone in a field study	105
5.2.3	Detailed study of the impact of diaphragm perforation on the frequency response by a systematic investigation	107
5.2.4	Discussion and conclusions	112
6	Conclusion & Outlook	115
	Bibliography	117