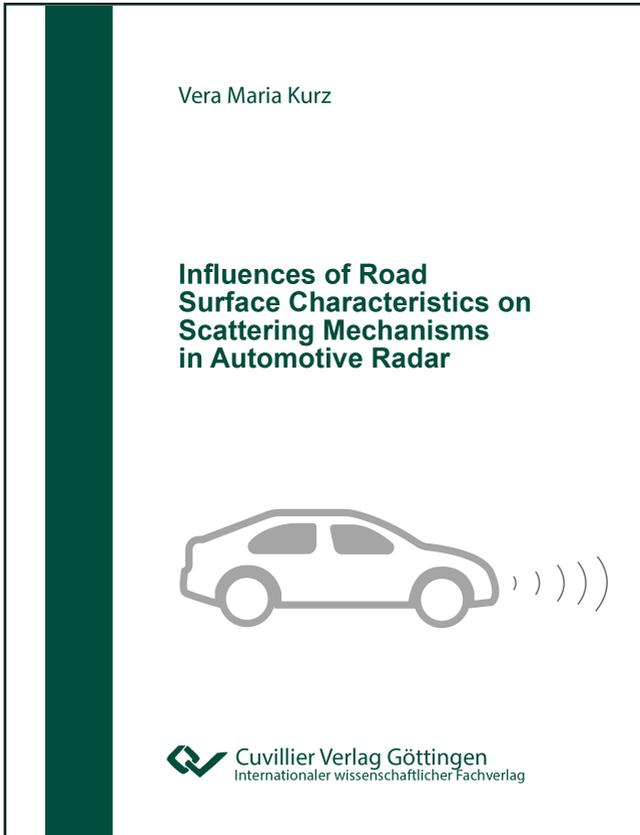




Vera Kurz (Autor)

Influences of Road Surface Characteristics on Scattering Mechanisms in Automotive Radar



<https://cuvillier.de/de/shop/publications/9044>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen, Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Contents

1	Introduction	1
1.1	State of the Art	3
1.2	Goals and Content of this Work	4
2	Fundamentals and First Estimates	7
2.1	Electromagnetic Waves	7
2.1.1	Plane Wave and Far-Field Condition	8
2.1.2	Polarization	9
2.1.3	Incidence at a Dielectric Surface	10
2.2	Radar Basics	12
2.2.1	Frequency Modulated Continuous Wave Radar	12
2.2.2	Automotive Radar	19
2.2.3	Penetration Depth	19
2.2.4	Synthetic Aperture Radar	20
2.3	Road Construction and Composition	24
2.3.1	Asphalt	25
2.3.2	Concrete	29
2.4	Material Properties	30
2.4.1	Permittivity and Permeability	30
2.4.2	Permittivity Measurements using the Focus Beam Method	31
2.4.3	Reflectance	32
2.4.4	Roughness	33
2.5	Statistical Distributions	36
2.5.1	Relevant Terms	37
2.5.2	Normal distribution	38
2.5.3	Weibull and Rayleigh Distribution	39
2.6	Relevant Terms in Measurement Engineering	40
2.6.1	Resolution, Accuracy, and Precision	40
2.6.2	Errors of Measurement	40
2.6.3	Measurement Uncertainty	41
3	SAR Measurements	43
3.1	Measurement Setup	43
3.2	Road Samples	45
3.3	Validation of the Setup	46
3.4	Measurement Results	48
3.4.1	Survey of the Validation Samples	50

3.4.2	Survey of the Road Samples	53
3.4.3	Polarization	57
3.5	Characterization of Roads by Probability Density Functions	60
3.6	Concluding Remarks	61
4	Openspace Measurements and Permittivity Calculations	65
4.1	Testing Ground	65
4.1.1	Requirements to an Openspace Measurement Environment	67
4.1.2	duraBAST	67
4.1.3	Available Materials	68
4.2	Roughness	69
4.3	Setup	71
4.3.1	Radar Sensor	71
4.3.2	Target	72
4.3.3	Signal Path	74
4.4	Signal Model	77
4.5	Results	80
4.5.1	Data Processing	80
4.5.2	Surface Characterization	80
4.6	Measurement Deviations and Uncertainties	83
4.7	Concluding Remarks	84
5	Database for Sensor Simulation	87
5.1	OpenMATERIAL	87
5.2	Included Data	89
5.3	Data Implementation in Progress	89
5.4	Future Objectives	90
6	Conclusion and Outlook	93
	List of Symbols	95
	List of Acronyms	97
	Bibliography	99
	Own Publications	110