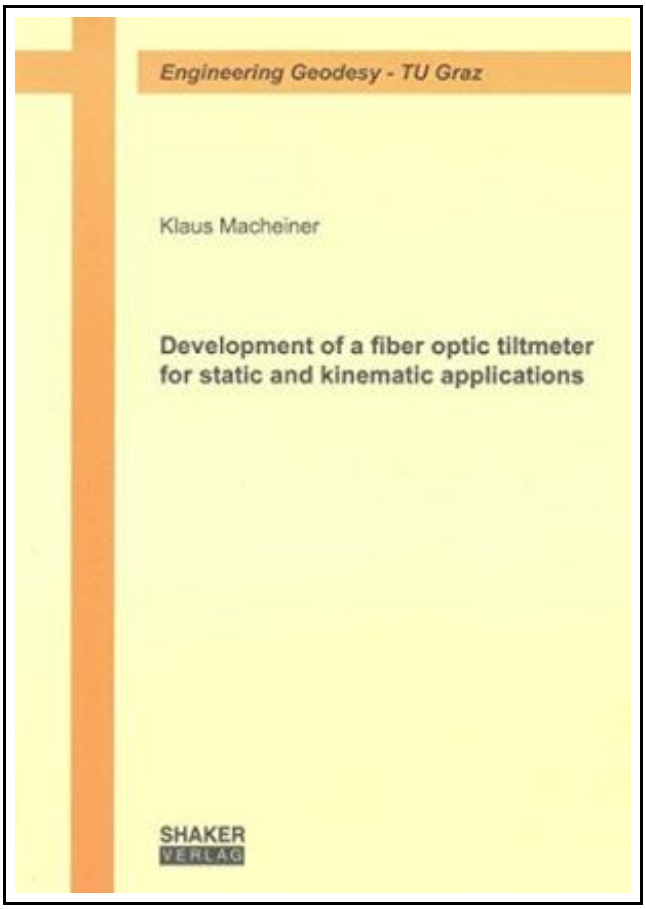
Development of a fiber optic tiltmeter for static and kinematic applications



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DEVELOPMENT OF A FIBER OPTIC TILTMETER FOR STATIC AND KINEMATIC APPLICATIONS

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Shaker Verlag Apr 2010, 2010. Taschenbuch. Book Condition: Neu. 211x151x20 mm. Neuware - Engineering geodesists are accustomed to selecting appropriate sensors for often challenging and highly accurate measurements, but usually not to contributing directly to the sensor development. Knowledge in electronics, mechanical modeling, system theory and precision mechanics is required, which is beyond the basic education of geodesists. However, basic essentials of the geodetic education are instrumentation, signal processing and parameter estimation - also necessary requirements in sensor technology. Consequently, the attempt of combining these fields is made in this thesis. The thesis is concerned with the development of a tiltmeter whose sensing element consists of a fiber optic cantilever. Tilt measurements are common observations in engineering geodesy, and the determination of the instantaneous inclination is a challenging task, especially in the kinematic case. Moreover, fiber optic sensor technology gains more and more importance due to the superior performance in harsh environments. By reviewing existing sensors - conventional tiltmeters, fiber optic cantilever sensors and fiber optic tiltmeters - the straightforward and advantageous principle of using a bare fiber as a sensing element for tilt angles in two orthogonal axes is developed. Based on this review, a prototype development is described. The mechanical component of the tiltmeter, i.e., the sensor element itself, is supposed to act like a cantilever experiencing biaxial deflections. This is investigated in detail for the static and dynamic case to obtain a better understanding of what is happening inside the sensor development during operation. Experimental results excellently confirm the mathematical and mechanical models. Light guided within the fiber can directly be used to monitor the deflections of the sensor element on a position detector, and these deflections are proportional to the tilt angles. The biaxial tilt angles are derived from the (quasi-) static acceleration component, which requires...

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