Abstract

In recent years resonators have been used in more and more applications, such as in gyroscopes. These devices can measure the angular velocity without any external reference. Thereby electrostatic-comb drives are often used as driving and detecting structures. Since detailed information about the frequency-dependent behaviour of these structures are of utmost importance for the use in gyroscopes these properties are characterized and investigated in this work.

The static and dynamic behaviour by assumption of linear and nonlinear spring and driving force, respectively, are described in the theoretical part of this thesis. The change in capacitance in drive direction was simulated by the help of the finite-element-method for these considerations. Furthermore, the influence of the levitation effect was taken into account and the resulting effects on the behaviour of the comb structure were discussed.

Comprehensive measurements were made to verify the theoretical results. These measurements were accomplished by the use of an optical measuring system allowing the investigation of static lateral displacements as well as the study of harmonic and transient lateral motion. All performed measurements indicate that the gap between fixed and movable comb fingers is the dominant design parameter. The applied voltage has also a strong influence on the resonance properties indicated by the shift of the peak of resonance. Additionally a dependence between the effective stiffness of the spring and the applied voltage can be observed. The nonlinear spring-softening is mainly caused by the nonlinear behaviour of the capacitance. In comparison, the levitation effect has only a minor influence on the investigated structures.

Based on these results the optimal biasing of the drive oscillation under the aspect of reducing the cost and effort of the control circuitry is finally discussed.