Abstract

The aim of this thesis is to make the performance of Inertial MEMS (micro electro mechanical system) sensor suitable for neurological disease diagnosis. Different types of applications have different requirements. For example, some applications require higher performance in terms of sensitivity and precision whereas others may require sensors with smaller dimensions. Tremor (2 Hz−12 Hz) and seizure (0.5 Hz−29 Hz) are the symptoms of neurological disorders which require wearable sensors for continuous monitoring, specially for capturing feeble tremor. Therefore the sensors must have low mass, small size, high sensitivity and precision. Sensors which are very small, usually suffer poor resolution and sensitivity. A low mass sensor is required because it does not obstruct the motor task and can capture feeble signals for better performance with low noise floor. Usually, a single axis MEMS accelerometer if placed normal to the surface of the skin mainly the dorsum of the hand, can capture such feeble signals. It may be mentioned that the geometry of the structure may be responsible for slight rotation or tilt in the device. This gives rise to off axis acceleration being picked up by the accelerometer, which is responsible for cross axis sensitivity. The cross axis sensitivity must be as low as possible specially for detecting tremor jerks of the feeble type. The reduction of cross axis sensitivity has been done in two ways, first by geometric optimization and second by Wheatstone bridge scheme. In order to enhance the performance of the microsensor a noise reduction scheme has been proposed. The damping aspect of the proposed accelerometer has been investigated. An attempt has been made to design a low g wearable piezoresistive MEMS accelerometer of quad beam type of pure silicon, for the diagnosis of neurological disorders. The accelerometer designed here is to be used in strap-down medical diagnostic purpose for capturing feeble tremor having intensity which may be as low as 0 g signifying fall to maximum ±6 g signifying jerks. The sensitivity obtained for a dynamic range of ±6 g is 0.33 mV/V/g, noise floor is 7.65 $\mu g/\sqrt{\text{Hz}}$ and cross axis sensitivity is 0.48%.