Sub-1-Degree/Hr High-Performance Microgyroscope

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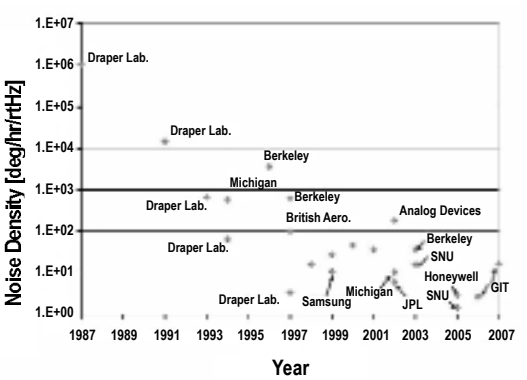

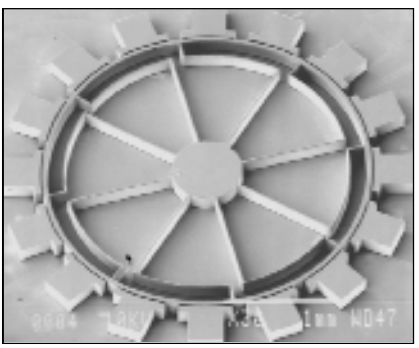

Left – Performance (reported in literature) of micromachined inertial gyroscopes as a function of time, Right – Single crystal silicon vibratory ring gyro developed in 2002, resolution: 7.5°/hr, Q: 14000.

Microgyroscopes are currently used in a variety of fields including military, automotive, guidance, and consumer products. However, there is still no microgyroscope with resolution and bias stability below 1 degree/hr for "inertial grade" sensing. This project aims to investigate the limiting factors in the resolution and bias stability, and to develop navigation grade microgyroscopes. Resolution of a microgyroscope depends on quality factor (Q), sensor mass, interface circuitry, and matching of driving and sensing frequencies. Q is related with sensor material, fabrication process, dimension, and vacuum level where the sensor operates. Frequencies of driving and sensing resonance modes have to be closely matched to increase the amplitude gain from Coriolis force, and their frequencies have to be lower than any unnecessary mode. Bias stability is lowered by precise and reliable fabrication process, low sensitivity to the structural stress, and stable temperature control inside the gyro package. The WIMS Center has been involved in the gyro research for a decade, and has made significant improvements in this area. Shown above is the single-crystal silicon vibratory ring gyroscope that demonstrated a good resolution for the tactical-grade sensing. So far, we have developed a new type of microgyroscope which has demonstrated superior quality factor and improved performance. Testing of this new design is underway. This project is supported by the Defense Advanced Research Projects Agency HERMIT program under contract number W31P4Q-04-1-R001.