TP01

Invited Session I (MEMS)

13:30-15:30 **Chair1 : Dong-il "Dan" Cho (Seoul National Univ., Korea)**
Room : 1st Floor-Mozart **Chair2 :**

13:30 – 14:10

- Invited Talk I
  - MEMS Gyro Sensors for Control Applications: State-of-the-art Review and Prospects

14:10 – 14:30 **TP01-1**

Mechanically Modulated Actuators and Branched Finger Detectors for Nano-Precision MEMS Applications

Young-Ho Cho, Won Chul Lee, Ki Ho Han(KAIST, KOREA)

We present nanoactuators and nanodetectors for high-precision Micro Electro Mechanical System (MEMS) applications. Major technical difficulties in the high-precision MEMS are arising from the fabrication uncertainty and electrical noise problems. In this paper, we present high-precision actuators and detectors, overcoming the technical limitations placed by the conventional MEMS technology.
For the nano-precision actuation, we present a nonlinearly modulated digital actuator (NMDA). NMDA composed of a digital microactuator and a nonlinear micromechanical modulator. The nonlinear micromechanical modulator is intended to purify the actuation errors in the stroke of the digital a...

14:30 – 14:50 **TP01-2**

Adaptive Control for the Conventional Mode of Operation of MEMS Gyroscopes

Sungsu Park, Roberto Horowitz(UC Berkeley, USA)

This paper presents adaptive add-on control algorithms for theconventional mode of operation of MEMS z-axis gyroscopes. This scheme is realized by adding an outer loop to a conventional force-balancing scheme that includes a parameter estimation algorithm. The parameter adaptation algorithm estimates the angular rate, identifies and compensates the quadrature error, and may permit on-line automatic mode tuning. The convergence and resolution analysis show that the proposed adaptive add-on control scheme prevents the angular rate estimate from being contaminated by the quadrature error, while keeping ideal resolution performance of a conventional force-balancing scheme.

14:50 – 15:10 **TP01-3**

Feedback Controller Design for a In-plane Gimbaled Micro Gyroscope Using H-infinity and State Weighted Model Reduction Techniques

Jin Woo Song, Jang Gyu Lee(Seoul Nat'l Univ., KOREA), Taesam Kang(Konkuk Univ., KOREA), Yong Kweon Kim(Seoul Nat'l Univ., KOREA), Hakyoung Chung(MicroInfinity Co. Ltd., KOREA), Hyun Kee Chang(Intellimicrons Co. Ltd., KOREA)

In this paper, presented is a feedback control loop, for an in-plane gimbaled micro gyroscope based on methodology and state weighted model reduction technique. The micro gyroscope is the basic inertial sensors. To improve the performances such as stability, wide dynamic range, bandwidth and especially robustness, it is necessary to design a feedback control loop, which must be robust, because the manufacturing process errors can be large. Especially, to obtain wide bandwidth, the feedback controller is indispensable, because the gyroscope is high Q factor system and has small open loop bandwidth. Moreover, the feedback controller reduces the effect ...

15:10 – 15:30 **TP01-4**

Feedback Loop Design for Micro Gyroscope

Woon Tahk Sung, Jin Woo Song, Jang Gyu Lee(Seoul Nat'l Univ., KOREA), Taesam Kang(Konkuk Univ., KOREA)

This paper presents a design and implementation of a PID feedback control loop for micro gyroscope. The feedback control loop improves the gyroscope performance such as linearity, bandwidth, and bias stability for micro gyroscope which is basically a high-Q system and exhibits a low performance with an open loop control. The designed and implemented feedback control loop is applied to the SNU-Bosch MEMS gyroscope to demonstrate the improvement with the feedback control loop. The bandwidth is improved to 60Hz from 25Hz of open loop control. The linearity becomes 0.5% from 1%. The bias stability is improved to 0.03 deg/sec from 0.06 deg/sec.