High-Q Hemispherical Resonators of Solid-State Coriolis Gyroscopes for Space Applications and Other Missions

Description
A novel design and key technological elements of a shell resonator for a solid-state Coriolis vibratory sensor of HRG type has been developed. This hemispherical resonator has been fabricated from high-purity quartz glass (together with its supporting stem). This key element of the device is supported by original fixture in a glass case, and have also DSP electronics. The original control loops stabilize the wave pattern and have regimes both of a rate gyro (with a rebalance loop) and of an integrating gyro (a whole-angle mode). A set of three single-axis sensors can be also mounted in a single vacuumed cover.

Innovative Aspect and Main Advantages
To minimize risks of the development for so specific applications as long-term space missions the STM’s resonators looks like their analogs in HRG130, which is the best US sensor for NASA space missions ("Cassini") and for oil industry (Northrop Grumman Corp., earlier – Litton Guidance & Control Systems and Delco Electronics / GM), they have also a French analog (Sagem Defense Securite). However, the proposed STM’s designs have notable particularities in fine structure of resonator, its filming, fixture, mismatch tunings and assembling technologies that are very essential for better operational characteristics of the gyro as a whole.

Areas of Application
Satellites (stabilization and navigation for long-term space missions); Oil& gas industry (inclinometry of wells and drilling); another autonomous (stand-alone) reference (strap-down) navigation systems.

Stage of Development
Several generations of quartz-glass resonators have been successfully designed by STM Co. / ATSU during over two decades of Solid-State Gyroscopy development in Ukraine. The complete design of the device as a whole has been developed to a customer/partner basing on the positive STM experience of previous HRG developments. Thus,

✓ on technological and material level, – it is mature design ready for market;
✓ on resonator level and on electronics level, – it is available for demonstration; and
✓ on level of a complete instrument (and/or INS), – it can be developed in a variant tailored to customer's specs, basing on our previous HRG designs, including original elements of all control loops & electronics.

All original designs and know-how developed by experts of STM Co./ATSU (a private spin-off of a Special DB). The designs and technique have fine engineering support thanks to the deep insights in math tools like detailed analytic modeling by perturbation methods, FEM simulation, close-loop analyses of these precise instruments, special DSP software, etc. Joint teamwork, patenting and/or investments to meet a new variant of specs would be discussed too.

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