DRIFT/VISC: DISTRIBUTED, REDUNDANT, AND INHERENTLY FAULT TOLERANT MICROPROBE CONCEPT

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ABSTRACT

MEMS (Micro-Electro-Mechanical-System) are already a key enabling technology for a number of technical challenges in the space sector, delivering mass-specific and power-specific performance and capability that exceeds conventional technologies by orders of magnitude. Since MEMS reuse IC fabrication technology, they can be readily mass produced. System-on-Chip has already been considered as a paradigm leading to single-board spacecraft, and spacecraft-on-a-chip. In this paper, we assume this interest and trend will continue. This paper proposes a possible way of using multiple probes to form a more capable observation and processing system. This highly distributed computer composed of distinct probes is then considered as a mission design concept.

We eliminate the tangible presence of the memory from the probe, and only fabricate the hardware for each probe CPU on the probe together with the radio circuits already needed to relay information, thus taking the concept of RISC a step further to form VISC – the Vacuum Instruction Set Computer. The principal novelty here is that the 'storage' for the VISC is the RF signal as it propagates. During the radio propagation time between probes, many distinct bits may be in transit. While any particular bit may be lost or corrupted, error correcting codes allow such errors to be detected and corrected, using minimal extra circuitry. The deployment of a large number of such probes (for example, into an atmosphere) provides a longer time-scale observation of structure and dynamics than can be achieved with individual complex probes. These relatively inexpensive devices also form a distributed, redundant and inherently fault tolerant (DRIFT), processing platform for handling the collected data.

A concept design for DRIFT is presented, with a functional model of VISC and its instruction set, together with simulations of probe interactions and system level performance estimates. Engineering challenges and the applicability to exploration is considered.