Sensors Requirements and Roadmaps Part 2

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ABSTRACT

Based on the findings of the previous lecture, one could draw the conclusion that new sensing principles and new technologies may be required to meet future requirements which cannot be fulfilled with the available sensing principles and technologies, particularly due to the high temperature requirement for such sensors. A significant class of sensors are not available yet as per today but they are promising into realization of classes of pressure, rpm, tip passing and tip gap that could operate for long time in the compressor, combuster or turbine environment. Although such technologies are not available yet or the technology readiness is at a very low level, modeling and extensive simulations have shown that the specific technologies are strong candidate for the future gas turbine engines. The new technologies could be classified according to their focus on:

- *New detection principles technologies*
- *Measurement in high temperature environments*

The two foci are mainly coupled by the future needs in the propulsion system industry to achieve the adaptive distributed control more intelligent gas turbine engine. Moreover, the lecture will address the progress carried out in packaging technologies as a major driving factor in building reliable sensors for the extreme environment conditions required by the gas turbine engines. The discussed technologies are MEMS on Si, MEMS on SOI, MEMS on SiC, SiCN, SiCN + alloys, Spintronics, Optical MEMS, Signal transmission technologies, MEMS packaging, Laser spectroscopy. Miniaturization is foreseen as a major principle of thinking when sensors implementation in a GTE is under discussion. Low mass and low power consumption are the main factors of consideration in any aircraft engine. Sensors packaging and embedding are discussed in the lecture. A number of emerging sensors are further discussed. Such sensors are of interest for the future distributed control GTEs but not yet available even as prototypes or measurement principle. Few examples are discussed such as the fuel sensor, which function is to detect the quality of the fuel and adapt the regime of flight accordingly to the optimized amount of fuel distributed to the nozzles.
Further, a comprehensive roadmap of such needed sensors, the foreseen technology or technologies that could help in their development, the specific requirements (operating environment and performance) are discussed in detail in a table format, This configuration helps on perceiving the needs and also the potential technologies that could carry out the accomplishment of such sensors. The TRL levels of the discussed technologies are set base on the present knowledge of the technologies and the effort in research (number of publication trend) over the past three years.
The roadmap represents the projection in the future of the past and present trends. However, this information might be used when the match of technologies with sensing technologies is targeted. For an example, adaptive gas flow path requires both sensing and actuators but also it requires the advancement of knowledge in the phenomena associated to the change in the cross section of the flow path during a flight mission. A projected image and the critical path for such a development of a practical technology could be made using the roadmap of sensors development.