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► **To cite this version:**

Hervé Aubert, Dominique Henry, Patrick Pons. Recent Advances in the Wireless Reading of Passive Sensors . IEEE Nanotechnology Materials and Devices Conference (NMDC), Oct 2017, Singapour, Singapore. hal-01596477

**HAL Id: hal-01596477**

**<https://laas.hal.science/hal-01596477>**

Submitted on 27 Sep 2017

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## **{Invited talk} Recent Advances in the Wireless Reading of Passive Sensors**

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*Abstract* – The remote measurement of physical or chemical quantities from the wireless reading of active electronic devices with integrated sensors is no more a major issue. Such devices with sensing, identification and communication capabilities can be used as nodes of a network and, more generally, part of the *Internet of Things*. Passive (batteryless) sensors could be used as sensing nodes in order to ensure unlimited energy autonomy, long-term measurement stability, low-cost of fabrication and operability in harsh or severe environments. However the interrogation range achievable by passive RFID sensors does not exceed 20 meters in harsh and/or highly reflective environments. An alternative solution to RFID sensors technology will be presented at the conference. It consists of applying an active millimeter-wave radar imaging technique to the detection and long-range reading of passive sensors. The use of millimeter-waves frequency for the wireless interrogation of sensors rather than lower frequency offers many advantages, such as, higher electrical length separation distances to objects located around the sensors, higher robustness to multi-paths, smaller sensors and reader antenna sizes, higher frequency bandwidth and compact design for beamforming, multi-beam or beam-steering Radar reader. The first part of the presentation will be devoted to the technology used by the authors and his collaborators at LAAS-CNRS, Toulouse, France, for fabricating miniaturized millimeter-wave passive sensors. Some recent sensors based on MEMS, microfluidic and/or ink-jet printing technologies will be presented. Next an active radar imaging technique will be reported for the long-range reading (up to 50 meters) of these passive millimeter-wave sensors. It consists of performing the beam scanning of the radar main lobe and/or translating the radar for illuminating the scene incorporating the sensors at different angles in order to obtain a 3D radar image. Statistical estimators are then computed from this image for remotely deriving the physical quantity of interest. Very recent results will be reported and discussed at the conference. The technical challenges and possible solutions regarding the fabrication of miniaturized and wireless passive sensors will also be presented.