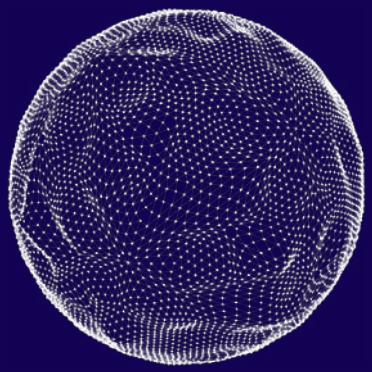


AHEAD

Advanced Heat Exchange Devices

PUBLIC SUMMARY

The SWAP project in ATTRACT Phase 1 (a partnership between CERN and CSEM) successfully demonstrated the feasibility of 3D-printed segments of pipes, equipped with printed standard hydraulic fittings, integrating an Aerosol Jet printed RTDs in the inner wall of the pipe, i.e. in direct contact with the fluid. Further developments pursued by CSEM after the end of SWAP improved the quality of the printing, essentially eliminating any need of mechanical post-processing and consolidating the full closure of the instrumented section by resuming the 3D printing operation after the sensor deposition by Aerosol Jet.

Furthermore, experience have been made in the introduction of COTS ("Commercial Out of The Shelf") miniaturized sensors in the process of 3D printing: this paves the way to the possibility of adding to the temperature sensing the capability for the instrumented pipe to host elements not suited for Aerosol Jet printing: e.g. miniaturized pressure sensors, or miniaturized flow sensors.

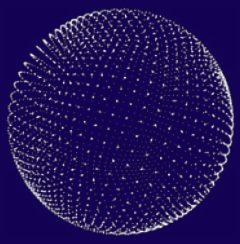
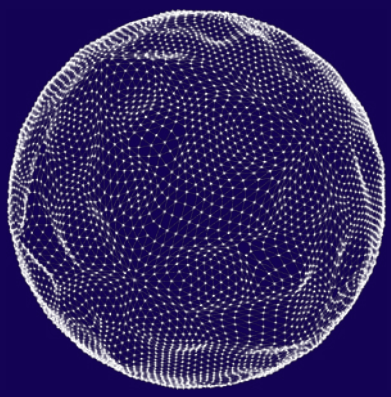
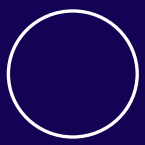
The main goal of AHEAD is to start from these technology bricks to develop a TRL7 product, bringing the possibility of sensing fluid parameters with a simple pipe segment to an industrial pre-production level, compatible with natural refrigerants: Carbon Dioxide (for detector applications) and Ammonia (for space applications). The reach this goal, two use-cases will be developed: the so called "Refrigeration" use-case targeting earth applications and the "MPL" use-case (Mechanically Pumped Loop) targeting thermal management applications for satellite platforms.

The partners in the proposal gather two beneficiaries mastering all the required technological steps for the full development of the product (CSEM and LISI Aerospace) and a set of end-users (CERN, Thales Alenia Space and NTNU) capable of performing accurate testing and product follow-up allowing for validation of prototypes at different steps of the project and for final qualification in field operation. In particular, the addition of NTNU to CERN and Thales will permit to study and qualify the extension of the potential application of the product to the market of natural refrigeration plants for general purpose terrestrial applications.

This will greatly reinforce the strength of the proposal in the context of ATTRACT, by directly introducing an aspect related to environment preservation and reduction of CO2 emissions. Meanwhile, in the parallel project ENERGY4OIL of ATTRACT Phase1, the Portuguese spin-off inanoEnergy has developed a technique of energy harvesting from turbulent flows, allowing to produce enough power to operate a sensor and enable wireless transmission of the data.

This technology is highly complementary to those developed in SWAP and to be developed in AHEAD. Indeed, the integration of energy harvesting shall enable standalone sensing and wireless data transmission for a very wide range of industrial and scientific IoT applications. The energy harvesting technology will be a central part of the so called "Refrigeration use-case" in AHEAD.

The advantages for future complex cooling systems at CERN is evident, introducing the possibility of an optimal tuning of the system performance on the basis of finely distributed local sensing, while largely reducing the cost and the integration impact of the monitoring instruments presently in use. For space applications, this is the optimization of the fluidic thermal control system by in-situ sensors and focused heating which is at stake with mass and compactness direct impact.

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