

Technology Transfer Demonstrators 2015

EATOPS

An Environmental On-board Control System

The scope of this technology demonstrator, referred to as "AutoGen", was to produce a 1-to-1 reproduction of an existing Fire & Gas detection system based on an equipment list description. The software engineering team produced a model together with a script to automatically generate the source code for the programmable logic controller – PLC – of a fire and gas detection control panel. This task would previously have been very labour intensive given the long list of sensors involved. The automation engineer also programmed the rules of cause and effect logic to fight the fire, again previously a repetitive manual task prone to errors. The EATOPS system complies with the ECSS standards (ECSS-E-ST-40C) for modelling and automatic code generation.

EATOPS has demonstrated the automatic generation of its PLC code in the context of a representative Oil and Gas safety system, which results in a significant cost saving to customers. AutoGen is a scalable solution, which reduces the programming time independent of the complexity of the offshore vessel. This technology opens up a whole new range of features for the control system such as the inclusion of artificial intelligence models. Such functionality is now requested from automation vendors which have to comply with Statoil's TR1494 or the ISA 18.2 international regulation.

SATE

Adaptive Transition Matrices for Online Novelty Detection

S.A.T.E. has developed a software tool for ESA named Knowledge Extraction Tool from TelemetrY (KETTY), for automatic behaviour detection and interpretation of spacecraft telemetry datasets. In particular, an enhanced version of one of the methods available in KETTY, named the Adaptive Transition Matrixes (ATM) method, is capable to automatically adjust the diagnostic system to the process being monitored, learning the system's "normal" functioning, without the need of a preliminary offline training phase of the diagnostic system.

This demonstrator project characterised the performance of the ATM method for the detection of sensors' anomalies or possible faults of the air system of a large internal combustion engine, produced by the corporation WÄRTSILÄ, which has expressed its concrete interest in the evaluation of the proposed technology.



Aircraft Design & Certification Ltd

Certification and technical issues of Optical & RF Constellations on Aircraft (ORCA)

The potential of commercial aircraft to carry small satellite payloads in order to provide Earth observation and communications functions is described by ESA PAT 651 (Optical and RF Constellations on Aircraft (ORCA)). The potential for this is highlighted by the fact that there are 30,000 commercial flights across Europe on a typical day, and each aeroplane flying at 10Km altitude has an instantaneous line of sight of 700km.
This technology demonstrator has shown that the ORCA concept is feasible, both from a technical and regulatory point of view.

National Centre for Scientific Research "Demokritos"

"Refra-Sense" Embedded refractory thickness monitor for kilns and furnaces

The project "Refra-Sense" has developed an industrial demonstrator of an embedded sensor for monitoring *in-situ* the thickness (i.e. the amount of wear) of the internal refractory lining of industrial boilers, kilns and furnaces. The Refra-Sense family of sensors includes a range of industrial sensors, originating from the "ReWiG" sensor, which was developed under an ITI/ESA project for monitoring the recession of the Thermal Protective System of space capsules and was the springboard for the development of the Refra-Sense technology. All the sensors are able to sustain long exposures at high temperatures while continuously monitoring the material thickness. A patent with multiple application areas was filed in October 2015 (application number GR20150100385).

The project has successfully enabled the demonstrator development and the current Technology Readiness Level of the Refra-Sense technology is estimated at TRL 6 (industrial demonstration). Monitoring and iterative optimisation of the sensors are expected to take another 6 months (till May or June 2016, to be funded by own funds after the end of this project) and once completed, the TRL of the new technology will reach 7.

European Sensor Systems

Standard Accuracy Pressure Transducer for Harsh Environments

ESS has developed a family of MEMS pressure transducers for measuring the static pressure of satellite propellant tanks. These transducers for Space are entirely fabricated from titanium, which is resistant to corrosion. This offers the possibility that these sensors could also find application in Earth-bound situations with extremely harsh environments and/or heavily corrosive media where the stainless steel pressure transducers that currently dominate the market cannot be used. Such applications include oil and gas exploration and maritime, but there are also medical applications since titanium is biologically and chemically neutral.

Thus the aim of the project was to construct a demonstrator device that retained all the positive characteristics of the Space pressure transducer, but used commercial (non Space qualified) components with similar performance but acceptable price and availability.

Tecnalia

CSTR Shield

The CSTR Shield project was designed to improve terrestrial solar energy applications by use of relevant Space technologies. Specifically, the aim was to design a new solar heatshield with improved properties compared to the state-of-the-art by making use of Space knowledge in tile design, thermal control paint selection, lightweight insulation and thermal simulations etc.

With the new thermal protection system it is estimated that the solar application market can achieve 80% value due to its comparable advantages in relation to maximum admissible radiation, service temperature, and lighter weight, reduction of thickness and ease of assembly. The manufacturing cost savings are estimated to be 30%-40% and the reduction in assembly time is 30%.

Tecnalia

AIRTMC

Metal matrix composites (MMCs) are a synthesized material in which a rigid ceramic reinforcement is embedded in a ductile metal or alloy matrix. The synthesized material combines the excellent properties of ceramics (typically high strength and modulus) and metals (ductility and toughness), leading to a greater strength in shear and compression and to higher service temperature capabilities.

The hybrid concept of TMC was developed for spacecraft robotic arms under contract from ESA. The hybrid TMC developed allows the stiffness and mechanical strength to be tailored to the application along the length of the component, combining particulate reinforced and fibre reinforced TMCs. Titanium metal matrix composite offers significant advantages in terms of weight saving and improved performance.

The objective of this project was to assess the potential for using metal matrix composite struts for various civil aircraft applications. The aim was to prove the manufacturing process as well as the materials for the selected type of applications. With this aim a hybrid configuration combining fibre and particulate reinforced TMCs has been manufactured and tested.



RUAG Space

Micro-Bioreactor Continuous Perfusion demonstrator

Cells have demonstrated an amazing potential for the production of therapeutic agents. Currently, most industrial biopharmaceutical production is carried out using large stirred tank steel bioreactors implementing fed-batch and batch cultivation technologies. The operation costs for such infrastructures are very high due to culture medium consumption, complex maintenance and sterilization protocols, and associated labour costs.

Within the demonstrator, the design of a mini-bioreactor has been considerably advanced and an existing fed-batch prototype system has been upgraded to support perfusion capabilities. This implies a number of achievements in terms of design, integration and verification. In particular the bubble-free mass transfer device is considered a most remarkable achievement and is unparalleled in any other technology currently available. Traditional aeration strategies for high-cell density applications are associated with heavy foam formation and resulting cell damage due to high energies produced when the bubbles burst at the liquid surface. The lack of bubbles will also simplify the quality control and product validation protocols by avoiding the need for additional cell protective and antifoam chemicals.