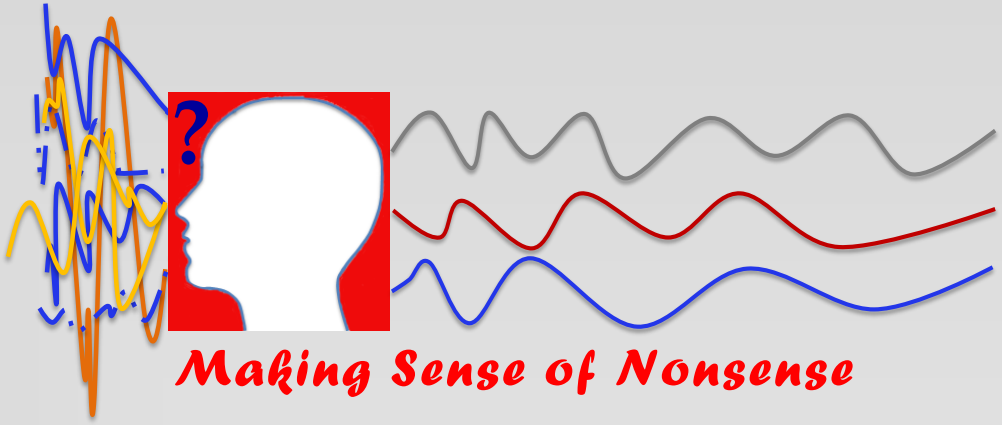

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University of Birmingham, U.K.

Universitat Politècnica de Catalunya, Spain

STMicroelectronics, Italy

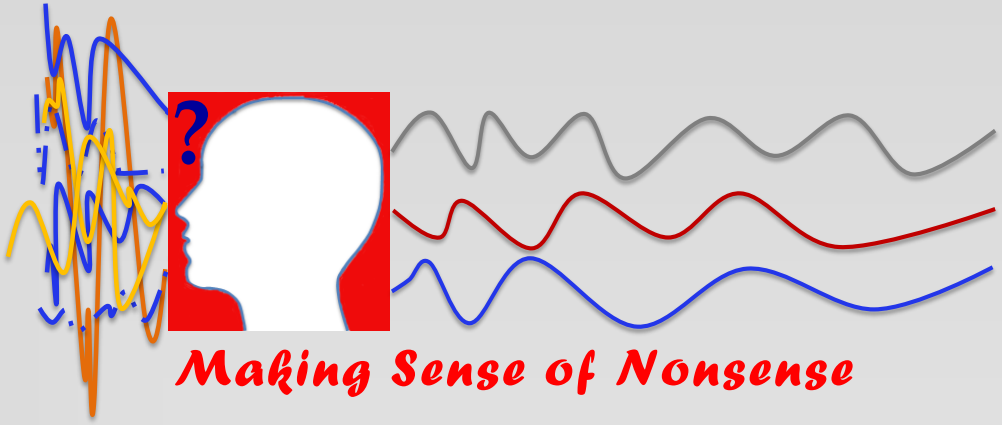
Factsheet
Starting Date: 1/1/2011
Duration: 36 months
Total Cost: 3.990.370 €
EU Contribution: 2.790.000 €
Contract No: INSFO-ICT-270428

Project Website
www.i-sense.org

Keywords Fault Diagnosis; Cognitive Fault Detection, Isolation and Identification; Fault Accommodation; Distributed Monitoring and Control; Hierarchical Fault Diagnosis; Real-Time Adaptive Learning Methods; Fault Tolerant Control

Motivation The emergence of networked embedded systems and sensor/actuator networks has made possible the collection of large amount of real-time data about a monitored environment. Depending on the application, such data may have different characteristics: multidimensional, multi-scale, spatially distributed, time series, etc. Moreover, the data values may be influenced by controlled variables, as well as by external environmental factors. However, in many cases the collected data may be incomplete, or it may not make sense for various reasons, thus compromising the sensor-environment interaction and possibly affecting the ability to manage and control key variables of the environment.

Objective The main objective of this project is to develop intelligent data processing methods for analyzing and interpreting the data such that faults are detected, isolated and identified as soon as possible, and accommodated for in future decisions or actuator actions. The problem becomes more challenging when these sensing/actuation systems are used in a wide range of environments which are not known a priori and, as a result, it is unrealistic to assume the existence of an accurate model for the behavior of various components in the monitored environment. Therefore, this project will focus on cognitive system approaches that can learn characteristics or system dynamics of the monitored environment and adapt their behavior and predict missing or inconsistent data to achieve fault tolerant monitoring and control.



i-Sense

Making Sense of Nonsense

WP 1-Specifications & Architecture

■ Specify the overall system characteristics, including the nominal system model, the class of uncertainties, and the characteristics of the measurements.
■ Formulate and analyse possible fault models that describe the evolution characteristics of the fault and the fault function.
■ Develop a class of system architectures for cognitive fault diagnosis and fault tolerant control.

WP Leader:
Prof. Cesare Alippi,
Politecnico di Milano

WP2-Cognitive Fault Diagnosis

■ Develop a theoretical framework for cognitive fault diagnosis that can be effectively applied to monitoring and control applications of uncertain distributed environments.
■ Design cognitive fault detection schemes for uncertain distributed environments.
■ Design cognitive fault isolation and identification schemes for uncertain distributed environments.
■ Analyze the performance properties of the designed cognitive fault diagnosis schemes

WP Leader:
Prof. Marios Polycarpou
University Of Cyprus

WP3 -Adaptation & Learning

■ Develop on-line learning methods to learn the characteristics or system dynamics of the monitored environment.
■ Design neural network ensemble learning algorithms for cognitive fault diagnosis.
■ Investigate ensemble approaches to class imbalance learning.
■ Explore multi-objective approaches and evolutionary dynamic optimization for online learning
■ Design a virtual sensor and actuator scheme for uncertain distributed environments.
■ Develop adaptive classification methods within a cognitive fault diagnosis framework.

WP Leader:
Prof. Xin Yao
University Of Birmingham

WP4 -Fault Tolerant Control

■ Develop a fault tolerant control formulation for uncertain distributed environments.
■ Develop an adaptive fault tolerant control method based on the passive fault tolerant control architecture.
■ Develop a unified fault tolerant control approach that combines information by cognitive fault diagnosis methods and fault accommodation of actuation devices.
■ Develop a fault tolerant model predictive control design method.
■ Analyze the stability and convergence properties of the designed fault tolerant control schemes.

WP Leader:
Prof. Joseba Quevedo
Universitat Politècnica de Catalunya

WP5 - iSense Platform Implementation

■ Integrate the various components and build a system prototype for the iSense Platform that can be used for distributed systems such as intelligent buildings, water distribution networks, power transmission and distribution grids and more.
■ Validate the performance of the developed iSense Platform in the context of distributed systems under a wide range of fault scenarios.
■ Evaluate the expected enhancement in fault tolerance achieved by the use of the iSense Platform and identify possible fundamental limitations in achieving cognitive fault diagnosis and fault tolerant control.

WP Leader:
Dr. Roberto Sannino
STmicroelectronics

Information and Communication Technologies
Cognitive Systems, Interaction and Robotics
Seventh Framework Programme