Brescia University: research activities on embedded systems & smart sensors

The research group on smart sensors and sensor networks, managed by Prof. Alessandra Flammini, is formed by three young researchers and some Ph.D. students. The research activities are often carried out in cooperation with research agencies and local companies.

Research activities include:

- **Real-time Communications for smart grids and industry; Clock Synchronization**
  Activities include experimental characterization and development of solutions and tools for smart grids (IEC61850) and industrial communications with particular attention to powerline communications and Real-Time Ethernet (RTE). The group developed, in cooperation with Gefran, the first Italian RTE (GDNET). It strictly cooperates with CSMT (Profibus and Profinet Competence Center). Recently, new solutions have been proposed for synchronization (IEEE1588) in communications for energy distribution.

- **Wireless sensor networks for metering and industry**
  The group developed patents and proprietary solutions in cooperation with local companies and, recently, experienced with M-bus for metering and WirelessHART and ISA-100 for industry. In the last year, the main research activity has concerned new technologies for multistandard wireless communications (Software Defined Radio) and synchronization.

- **Electronic noses, wearable sensors and smart devices**
  The group designed new electronic circuits (ASIC) and instruments for sensor experimental characterization (high-value sensor resistance measurement - from kΩ to over 100GΩ; small value sensor capacitance -pF-), together with other Italian Universities and with CNR Sensor Laboratory of Brescia (chemical sensors using new nanotechnologies -nanowires-). Attention is now focused on wearable sensors for health and exercises and smart devices for drugs, medicines and nutrition.

**Main cooperation with research units**

- Ubiquitous Sensor Networks Research Center, Hanyang University (Korea);
- Austrian Academy of Science (Wien, Austria)
- E.ON Energy Research Center (E.ON ERC), RWTH Aachen University
- Italian Universities (Padova, Trento, L’Aquila, Siena, Perugia)
- Commission for standards (IEC-65C-MT9, fieldbus and Real Time Ethernet, P. Ferrari; IEC-SC65C-WG16/17, wireless for industrial communications, E. Sisinni; IEC-TC65C, smart grids for industrial applications, CEI-65C)

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International cooperation:

- **Cooperation with**
  - CSMT (Profibus and Profinet Competence Center). Recently, new solutions have been proposed for synchronization (IEEE1588) in communications for energy distribution.
  - C.S.M.T.
  - www.csmt.it

- **Wireless sensor networks for industry**
  - Development of "ad hoc" solutions, active presence in Commissions for emerging standards (IEEE802.15.4) analysis

- **Wearable sensors and smart devices**
  - Biomedical Smart Sensing
  - Localization

- **Measurement instruments and sensor interfaces**
  - Distributed instrument for Real Time Ethernet and wireless traffic (IEEE802.15.4) analysis

- **Wireless Communications; if the number of new technologies is growing up too fast, architectures must change**
  - (Software Defined Radio for multistandard communications)

- **Synchronization for energy distribution**
  - IEEE1588 and IEC61850, smart grid

- **Industrial communications; competence center, research about synchronization, new technologies and new solution development**
  - Cooperates with

  - CSMT
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- **Wearable sensors and smart devices**
  - Smart device (indoor)
  - Localization

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More recent activities and publications:

- **Industrial communications and Wireless sensor networks**
  - C. M. De Dominicis, P. Ferrari, A. Flammini, E. Sisinni, "Wireless sensors exploiting IEEE802.15.4a for precise timestamping", 2010 Int. IEEE Symposium on Precision Clock Synchronization for Measurement Control and Communication (ISPCS), Portsmouth (NH), USA, September 27-October 1, 2010, pp. 48-54.

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- **Wearable sensors and smart devices**