

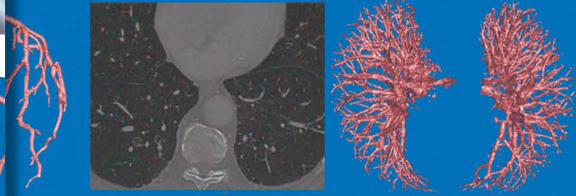
IOF Knowledge Center



Electronics and Informatics



Audiovisual content creation and man-machine interaction at AV Lab.



Blood vessel tree segmentation in medical images.

Electronics and Informatics

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leveraging on their experience in **parallel computing**, processing architectures and embedded systems. When needed, **optimized implementations** making use of GPU's and FPGA's, are also targetted. ETRO is also recognized for its expertise in **medical image analysis** and its contribution to **e-Health** via the development of personalized health systems. Researchers at ETRO developed several unique **media coding technologies** and contributed substantially to the standardization of image, video and 3D graphics representation and coding (JPEG and MPEG). **Strategic research** at ETRO is clustered in three ETRO-wide transdisciplinary areas: (i) Combined physical **image generation and image processing** for superior imaging systems, (ii) Audiovisual signal processing for **man-machine communication**, (iii) ICT Systems and applications based on wired/wireless **communication, on broadband networks and ad-hoc sensor networks**.

Focussed on **end-to-end system design** in its strategic research, ETRO fully understands the ecosystem in which its technical expertise and novel ICT components can be embedded. Evidence thereof can be found in the commercialization of a novel capacitive blindspot sensor for commercial vehicles by the spin-off '**eXia**', in the 3D time-of-flight sensor chips brought to market by an earlier spin-off '**Softkinetic-Optima**', in the equalizer technology that '**Eqologic**' successfully develops, in the multimedia platform offered by spin-off '**Universum Digitalis**' and novel cutting-edge sensor



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Expertise

The Department of **Electronics and Informatics** - ETRO, was established in 1971 and is part of the VUB Faculty of Engineering Sciences. As key **industrial research pole** - creator of four **spin-off companies** - and **group of excellence in Fundamental Research**, ETRO is a reliable partner for local and international industry, public services and hospitals. The multidisciplinary research group of more than 120 people gets inspired by unexplored engineering bottlenecks at the interface of various application domains: health care, automotive, media, surveillance, security, public safety, remote sensing, energy, telecommunications, creative industries...

In its **application driven research**, ETRO upholds a **close cooperation** with Belgian and international research institutes. A Joint Laboratory on audio-visual signal processing (AVSP) was founded with **Xi'an North Western Polytechnical University in China**. Research on integrated mm-wave sensors and their applications is carried out within ETRO's associated **IMEC** laboratory (BISENS - Brussels Integrated Sensor Laboratory). As co-founder of **iMinds**, ETRO is embedded in iMinds' Future Media and Imaging Department and ETRO is also partner of **Intel's Exascience lab**. The ETRO Department owns a **modern research infrastructure** including a state-of-the-art audiovisual recording studio, advanced high frequency measurement equipment (up to 700 GHz), a test lab for the visual quality of images, a CO2 laser lab used for rapid prototyping in microfluidics and a high-end visualization lab for holographic imaging and multiview video. This infrastructure is used to **make sense of audio, video, hyper-dimensional signals and sensors** for various sectors and to deliver **unique value** through the **multi-disciplinary engineering** approach.



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Crossing boundaries with visionary electronics and ICT

The department of **Electronics & Informatics** is built on three research groups that cover a wide range of generic technologies in **Micro- and Optoelectronics** (LAMI), **Speech & Audio Processing** (DSSP) and **Multidimensional Signal Processing & Communication** (IRIS). Staying ahead of obvious R&D tendencies in demand-driven research, fundamental research is oriented towards creating disruptive innovation in the knowledge society. Illustrations of such out-of-the-box thinking capacity are the early adoption of wavelets for coding and challenging the - at that time - dominating image compression paradigm of interband coding in favour of intraband and mixed intra-interband coding, the early invention of the now widely used WSOLA algorithm for time-scaling of audio & speech signals, and more recently the theoretical foundations for a new generation of millimeter-wave sensors. ETRO developed a culture of tackling the unknown which led to a broad scale of **2D/3D imaging** HW/SW expertise and new insights into dielectric **imaging and sensing** in applications ranging from process and product quality assessment, automotive technology, to material identification and non-destructive material testing. As designers of new algorithms in **image/video processing and analysis**, they go beyond laboratory simulations, considering computational complexity, execution speed-up and power minimization,

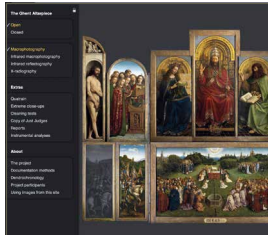
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modalities to monitor real-time and inline industrial processes over a multitude of sectors to boost them into the era of industry 4.0 by its latest spin-off **M2Wave/Aquantis**.



Softkinetic/Optrima (2009) demonstrates the world's first close interaction 3D camera capable of tracking hands and fingers from as close as 15cm.



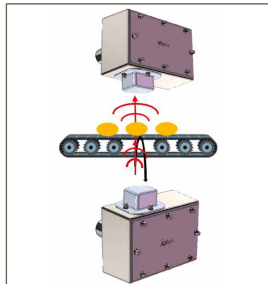
Universum Digitalis (2008) brings a huge collection of image data from the masterpiece 'The Ghent Altarpiece' to the public in a user friendly way.



Eqcologic (2005) showcases a transceiver circuit that sends signals bi-directionally over a single coax cable.



eXia (2013) develops unique sensor-based detection and warning systems for active guarding of the blind spots around commercial vehicles.



M2Wave/Aquantis (2014) uses fundamentally new insights into dielectric sensing at millimeter wave frequencies to offer novel cutting-edge sensor modalities to monitor real-time and inline industrial processes over a multitude of sectors to boost them into the era of industry 4.0.



Future challenges

Driven by end-to-end (E2E) interactive, distributed and mobile system design, by the invention of new devices (sensors and circuits), by signal processing, data acquisition, modeling and

representation, data transmission and storage, visualization, machine learning and data analysis, ETRO has acquired a solid reputation in **application driven R&D**. Main challenge today is to unfold a department-wide global fundamental research strategy - **processing of large multi-dimensional, multi-spectral, multisensorial and distributed data** - that further seeds the culture of fundamental research on ICT modules and their diverse associated application fields.

Sensor Design

- Mm & THz wave sensors
- Multi-spectral sensors
- Focus on sub-ns gating to improve Time Domain Reflectometry at pel-level

Data Modeling and Representation

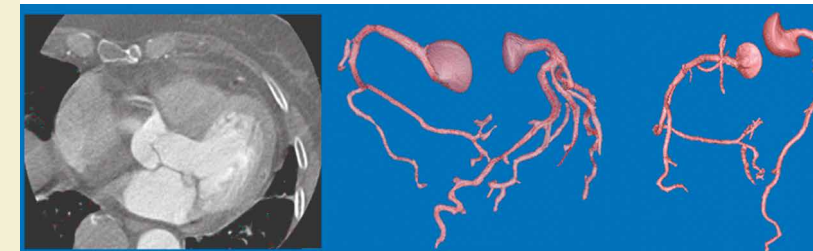
- Data reduction and flexible coding
- Exploit distributed nature in the spatio-temporal domain (correlation noise modeling & coding)
- Exploit sparsity in large data sets (adaptive multiresolution dictionaries, matching pursuits, compressive sensing & coding)
- Exploit simultaneous feature selection and classification in ill-dimensioned datasets

Data Analysis and Rendering

- New algorithms, E2E system design and support via distributed network topologies (load balancing), parallel processing (reduction techniques), system architectures (e.g. embedded systems, field programmable gate arrays, ...)

Seeded strategic application domains

- Sensing systems with focus on body area networks (smart pills);
- Sensing systems in production and distribution chains (food industry, retail);
- Bio-informatics systems (high-throughput sequencing, CAD tools);
- Multispectral systems for forensic analysis (art analysis, biometrics);
- Vision systems (plenoptic/lightfield camera systems, SAR systems);
- Medical imaging and computer based diagnosis (multimodal image analysis, perfusion imaging);
- Personal health systems (adapted to specific target groups like senior citizens, cerebral palsy children, ...);
- Remote sensing (humanitarian demining);
- Affective computing and man-machine interaction (dancing robot, serious gaming, ...);
- Audio-visual signal processing (avatars, text-to-visual speech, ...)



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