

chist-era Projects Seminar 2019

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Technological Vision and scientific approach

Key functionalities for adaptive workspace sharing in dynamic smart industrial environments:



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Localization of multiple subjects



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control via intuitive human-robot interfaces



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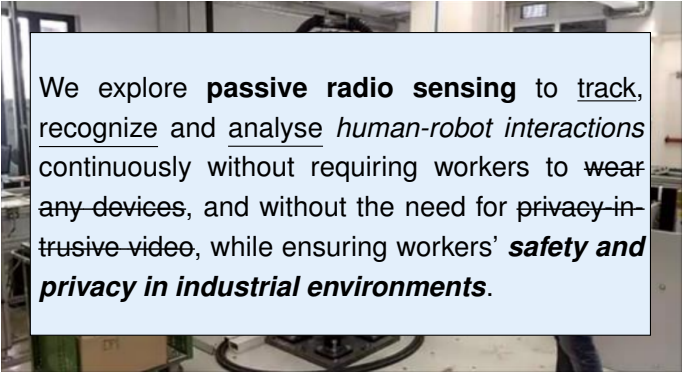
Localization of multiple subjects
control via intuitive human-robot interfaces
safety guarantee for workers in the workspace



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Key functionalities for adaptive workspace sharing in dynamic smart industrial environments:

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We explore **passive radio sensing** to track, recognize and analyse *human-robot interactions* continuously without requiring workers to wear ~~any devices~~, and without the need for ~~privacy-intrusive video~~, while ensuring workers' **safety and privacy in industrial environments**.

Key challenges and potential impact of the project

Scientific Challenges



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Device-free localization

non-intrusive multi-subject activity
tracking in industrial environments

Device-free control

recognizing in-air gestures as inputs
from non-instrumented workers

Device-free Safety Guarantee

ensure safety of workers in industrial
environments



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Evolution of IoT platform technologies

RadioSense kick-starts the development of novel environmental sensing and HRC interaction technologies that will generate new research domains in RF-recognition, localisation, behaviour sensing as well as HR interaction principles.

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Strengthen the industrial EU technological offer of innovative IoT solutions

The project will lay the groundwork for new interaction standards in smart environments. Since subjects need not be equipped with sensing hardware (device-free), implicit interaction through in-air gestures is possible.

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Contribution to emerging, future standards and pre-normative activities.

RadioSense guarantees interoperability with open standards (oneM2M: <http://www.onem2m.org>). We plan to interact with IEC (TC 44), ISO (TC 199 and TC 299) and IEEE P1752 Open mHealth. Co-operation with other H2020 projects.

Consortium and the role of the partners



Lead: WP1 (*Fundamental theory and emerging technology*)

WP1: Time-varying environments; Time, phase, frequency-domain, Fresnel- & diffraction-based recognition. Models and scaling laws for high-frequency technologies and massive MIMO.

Consortium and the role of the partners



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Lead: Project; WP2 (*Enabling functions for HRC workspaces*),

WP2: enabling functions to support hybrid production systems: device-free localization of multiple subjects, gesture control of machines, safety guarantee of workers

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Tech integration; WP3 (*Cloud Platform for Big Data processing*),

WP3: big-data and large scale distributed processing of CSI; data aggregation with other sensing devices. Maximize the recognition accuracy at minimum overall processing and storage cost.

Research results and scientific output

- 1 Stefano Savazzi, Stephan Sigg, Federico Vicentini, Sanaz Kianoush, Rainhard Findling:
On the use of stray wireless signals for sensing: a look beyond 5G for the next generation industry, in IEEE Computer, SI on Transformative Computing, (under Review).

On the use of stray wireless signals for sensing: a look beyond

5G for the next generation industry

Stefano Savazzi, Stephan Sigg, Federico Vicentini, Sanaz Kianoush, Rainhard Findling

Transformative techniques to capture and process wireless stray radiation originated from different radio sources are gaining increased attention. They can be applied to human sensing, behavior recognition, localization and mapping. The omnipresent radio-frequency (RF) stray radiation of wireless devices (WiFi, Cellular or any Personal/Body Area Network) encodes a view of all objects traversed by its propagation. A trained machine learning model is then applied to features extracted in real-time from radio signals to isolate body-induced footprints or environmental alterations. The technology can augment and transform existing radio-devices into ubiquitously distributed sensors that simultaneously act as wireless transmitters and receivers (e.g. fast time-multiplexed). Thereby, wireless networks transform into a dense web of RF-imaging links that extract a view of an environment. This article (1) highlights emerging transformative computing tools for radio sensing, (2) promotes key technology enablers that exceed current 5G installations and (3) reports deployment experiences with a focus on future industrial setups.

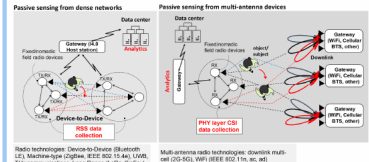


Figure 1: Configurations: transformation of dense low power networks (left) and smart multiple antenna devices (right) into sensors. Received Signal Strength (RSS) and PHY layer CSI collection and analysis.

Activities and future plans

to disseminate and exploit the research results

Dissemination:

Project webpage explain goals, partners, tasks of RadioSense. *Disseminate* results, press releases, WP reports. Interactive blog to answer questions of the public/stakeholders. Private area (coordination, share information and documentation, organize virtual meetings).

chist-era conferences participation and presentation of results

Conferences PerCom, Ubicomp, Mobicom, Infocom, ICASSP ...

Established high IF Magazines/Journals IEEE Comm. Mag., IEEE Signal Processing Mag., IEEE IoT J., IEEE T. on Mobile Computing,...

Booths in conferences or trade fairs to explain and demonstrate our solutions

Leaflets disseminated at conferences and fairs

Promotional videos disseminated via the webpage

Social media Twitter, YouTube, LinkedIn, ResearchGate

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Exploitation:

Standardization and pre-normative bodies oneM2M (<http://onem2m.org>)

promote standardization and safety requirements in radio-based sensors (i.e., ISO/TC 299, WG 3 'Industrial Robot Safety', ISO/TC 199, WG12 'Human-Machine physical interaction', IEEE P1752 Open mHealth).

exhibit project results at major trade fairs & exhibitions appropriate to the application cases.

Open source code publish algorithms, source code and data sets

Market/IP analysis to answer demand and evolution of collaborative robotic and next generation radio technologies

White paper During last 3 months, we will identify, analyse and summarize strategies for follow-up funding & co-financing the development of the subsequent phases to higher TRL (6-8).

Thank you!

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