NL-JP Joint Initiative for the Innovation in Radar Sensing for Human Health Monitoring

Idea of the workshop.

The **purpose** of the joint seminar is to bring together researchers from Dutch and Japanese institutions and foster cooperation around the broad topic of contactless sensing and monitoring technologies for human healthcare. Specifically, contactless sensing and monitoring technologies of our interest are based on radar systems employing radio frequency (RF) electromagnetic (EM) waves to measure physiological phenomena of interest related to human healthcare, including but not limited to patterns of activities of daily living, quality of walking gait, tremors in limbs, and vital signs such as respiration, heartbeat, blood pressure and arterial pulse.
The attractiveness of RF and radar sensing in this domain comes from its contactless capabilities, whereby the potential patients or fragile people monitored do not need to wear, carry, interact with additional devices, as well as from the lack of optical images or videos that sensing with cameras would instead entail.

An increasing body of literature demonstrated encouraging proof of concept results of radar and RF technologies for the healthcare applications briefly mentioned above, although it is recognised by the research community that further steps are needed for these technologies to fully develop and generate impact, specifically bridging the gap between engineering-led, technology-driven research, requirements from medical and primary care professionals, and needs and wishes of patients and end-users of the developed technologies.
With the initiative of this joint seminar, we aim to establish a joint research platform on the novel contactless radar-based technology that integrates two prominent measurement techniques; (1) one of them is related to the micro-Doppler effect caused by limb motion that is measured for human activity recognition, and (2) the other is related to the signal phase rotation caused by vital signs that is measured for human cardiopulmonary monitoring. These two are complementary areas of expertise of the Dutch and Japanese research teams that the proposed joint seminar will help combine to open up new opportunities and research directions.

Logistics and schedule.

-The workshop will take place at the **TU Delft campus, EWI building, on September 1-2 2022**.
-The location is the **Snijderszaal** (LB01.010, max 35 people for presentation/talks) and the **Timmanzaal** (LB01.170, for posters and serving of lunch/coffee).
-Presentation slots are **30 minutes including Q&A** session (about 22-25 minutes talk followed by Q&A).
-For online participation, please see **Zoom link** below:

Join Zoom Meeting
https://tudelft.zoom.us/j/94885113261?pwd=VFFxRGFDak40eEdkcXR3cTloR0dBQT09
Meeting ID: 948 8511 3261
Passcode: 302783

Programme of the workshop.

DAY 1 – September 01

9.00-9.30	Arrival and greetings; coffee served in the Timmanzaal.
9.30-11.00	Opening Session (Snijderszaal). • Welcome and opening by Dr F. Fioranelli, TU Delft. • Talk by Prof T. Sakamoto, Kyoto University, "*Recent Progress in Wireless Human Sensing".* • Talk by Prof A. Yarovoy, TU Delft, *"Challenges and approaches for radar sensing for vital signs and human activity recognition".*
11.00-11.30	Coffee Break (Timmanzaal)

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11.30-13.00	Session 1 (Snijderszaal). • Talk by Dr S. Wu, Osaka University, "*Non-contact Measurement in Healthcare Using Machine Learning Techniques".* • Online Talk by Mr I. Iwata, Kyoto University, "*Array Radar Imaging and Principal Component Analysis for High-precision Heart Rate Measurement".* • Online Talk by Mr Y. Tanaka, Kyoto University, "*Pulse Wave Measurement at Multiple Positions on Multiple Human Bodies Using 3D Radar Imaging".*
13.00-14.00	Lunch break (Timmanzaal)
14.00-16.00	Session 2 (Snijderszaal). • Talk by Mr S. Iwata, Kyoto University, "*Data Fusion Algorithm for Multi-radar Systems Using Respiratory Features".* • Talk by Mr T. Koshisaka, Kyoto University, "*Computational Reduction Method of Electromagnetic Scattering Analysis for the Measurement of Vital Signs".* • Talk by Mr W. Ziyue, Kyoto University, "*Accuracy Verification in Sleep Apnea Detection Using an EM Algorithm with a Millimeter-wave Radar System".* • Talk by Mr R. Guendel, TU Delft, *"Human Activity Recognition using Distributed Radars".*
16.00-17.30	Poster session & coffee break combined. (Timmanzaal) Approximately 10 posters will be presented during the session to stimulate discussion and exchange in an informal setting.
19.00	Dinner in Delft city centre for Japanese guest delegation.

DAY 2 – September 02

9.15-11.15	Session 3 (Snijderszaal). • Talk by Mr N. Kruse, TU Delft, *"Segmentation of Micro-Doppler Signatures of Human Sequential Activities using Rényi Entropy".* • Talk by Ms S. de Rooij, TU Delft, *"Epileptic Seizure Detection using a Tensor-Network Kalman Filter for LS-SVMs"* • Talk by Ms. E. Rufas Talamas, TU Delft, *"Multiple people detection and localization with multistatic UWB radar in multipath environments for automotive".* • Talk by Ms A. I. Karaiskou, KU Leuven, "*Closed-loop neurophysiology for stress regulation".*
11.15-11.30	Coffee break (Timmanzaal)
11.30-13.00	Session 4 (Snijderszaal). • Talk by Dr S. Hazra & Dr L. Servadei, Infineon, "*Robust Radar-based Vital Sensing with Adaptive Sinc Filtering and Random Body Motion Rejections*". • Talk by Dr M Bauduin, IMEC, "*A 140 GHz radar on and for your fingertip – exploring ultra-short range vital signs extraction*". • Talk by Dr S. Tertinek, NXP Semiconductors Austria, "*UWB radar applications (re-)using smart access infrastructure: Child presence detection and beyond*".
13.00-14.00	Lunch (Timmanzaal) and conclusion of the workshop.
14.00-15.30	Visit to laboratory on 22-23 floor and radars on the roof for Japanese guest delegation.

Upon consent of the authors, we would like to upload posters and presentations onto the shared folder below in order to share them with all attendees.
https://surfdrive.surf.nl/files/index.php/s/B2Bvowd8NECAlSo

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List of posters

	Main author	Affiliation	Title
1	Yubin Zhao	TUD (alumnus)	Angle-insensitive Human Motion and Posture Recognition Based on 4D imaging Radar
2	Yichuang Han	TUD (alumna)	An Approach for Sleep Apnea Detection based on Radar Spectrogram Envelopes
3	Elisabet Rufas	TUD	Detection and localization of multiple people in multipath environments for the automotive industry
4	Ronny Guendel	TUD	Human Activity Recognition using Distributed Radars
5	Nicolas Kruse	TUD	Segmentation of Micro-Doppler Signatures of Human Sequential Activities using Rényi Entropy
6	Julien Le Kernec	UoG (University of Glasgow)	A Holistic Human Activity Recognition Optimization Using AI Techniques
7	Caitlin Ramsey	TUD/Erasmus MC	Contactless Monitoring of Neonates in the Intensive Care Unit
8	Angeliki Ilektra Karaiskou	KU Leuven	Intra-rhythm and cross-rhythm functional brain connectivity as a determinant of the meditative state
9	Hanie Moghaddasi	TUD	Surface ECG reconstruction using intra-operative electrograms
10	Takehito Koshisaka	Kyoto University	Reduction of Computational Cost of Electromagnetic Scattering Analysis Based on a Physical Optics Approximation for Noncontact Human Measurement Using Millimeter-wave Radar
11	Ziyue Wang	Kyoto University	Use of EM Algorithm in Sleep Apnea Detection with a Millimeter-Wave Radar System
12	Shunsuke Iwata	Kyoto University	Multiradar Data Fusion Using Respiratory Features

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