Workshop 2024
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ABSTRACT PRESENTATION

Title: *Advancing Towards Multispectral Infrared Imaging*
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Provide abstract of 500 words maximum. Use font ARIAL, size 11.
If figures are used, the text plus figures must stay within this one page.

The market of thermal imaging cameras has grown continuously in recent years. The main drivers are uncooled infrared focal plane arrays (IRFPAs) based on microbolometer technology as they are low-cost imagers that do not require additional complex and expensive cooling systems. Most current thermal imaging applications are based on the detection of long-wave infrared (LWIR) radiation, covering wavelengths from 8 µm to 14 µm, which are sensitive to human body temperature and can be used not only in military applications, but also increasingly in mass market applications such as smartphones, surveillance cameras or autonomous vehicles. In addition, uncooled thermal imagers can be sensitive in the mid-wave infrared (MWIR), with wavelengths ranging from 3 µm to 5 µm. MWIR-sensors can be used in applications such as monitoring "hot sources" with temperatures of several hundred Celsius, detecting hazardous or flammable gases, or environmental monitoring. The realisation of multispectral imaging in the infrared region has attracted considerable attention due to its ability to visualise and combine information from the MWIR and LWIR regions.

Microbolometers as sensing elements of an uncooled IRFPA operate on the thermal principle. They are freestanding and thermally insulated sensor membranes. They absorb IR radiation and convert it into a temperature rise. The change in temperature of the microbolometer membrane causes a change in electrical resistance as a function of the incident power. A CMOS readout circuit converts the temperature-dependent resistance change of the microbolometers into digital values and generates an image.

A promising approach to achieve multispectral absorption is the use of a plasmonic metamaterial absorber (PMA). In the last decades, the field of plasmonics has received considerable attention for its various potential applications, especially in the visible spectral range. The study of plasmonic structures has also been extended to the IR region in order to achieve high absorption and to tailor the absorption wavelength in the MWIR and LWIR spectral regions. Promising candidates for the realisation of a suitable absorber adaptable to the microbolometer technology of Fraunhofer IMS are metal-insulator-metal (MIM) structures consisting of upper periodic metal structures, a middle dielectric layer and a lower metal reflector layer to generate strong localised surface plasmon resonance at the desired absorption wavelengths. Material selection, deposition techniques and patterning processes have been investigated at Fraunhofer IMS to achieve highly sensitive multispectral thermal imaging.

Fraunhofer IMS will report on its progress towards the realisation of multispectral infrared imaging. It will present the latest results of simulation and experimental characterisation of microbolometers with plasmonic metamaterial absorbers for multispectral infrared imaging.

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