META-HILIGHT

Adaptive Metamaterials for Smart Standalone Histopathology with Polarized Light

PUBLIC SUMMARY

Utilizing a novel platform for breakthrough optical systems relying on adaptive metamaterial-based optics for visible light, the META-HILIGHT project aims to realise a radically new diagnostic modality for stand-alone sensing and quantitative characterisation of biological tissues. This will be an important step towards a miniaturized and automated digital histopathology diagnostic tool that can be used in real-time for detection of cancer, Alzheimer and other chronic diseases.

To realise this goal, META-HILIGHT combines world leading expertise in Nanophotonics and Metamaterials from the University of Southern Denmark, Micro-Electro-Mechanical-Systems (MEMS) from SINTEF and bio-photonics from the University of Oulu, in radical cross-disciplinary technology-convergent research and development towards overcoming the inhibitive size, weight and cost paradigm of advanced optical sensor and imaging systems for medical diagnostics.

The META-HILIGHT objectives are:

1. Breakthrough adaptive optical metamaterial waveplate for polarization state control: our proposed adaptive metamaterial platform provides on-chip, ultra-fast (>1kHz) and high range modulations for control of the polarization state of light, enabling novel miniature optical diagnostic tools. State of the art optical modulation typically relies on large components (e.g. motors), is slow (e.g. liquid crystals) or has limited modulation range (e.g. refractive index tuning).

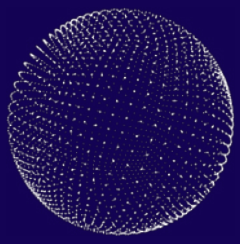
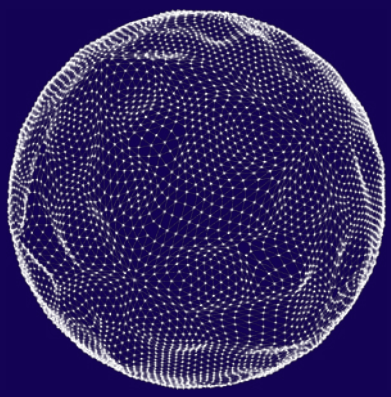
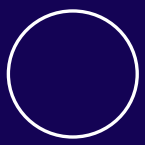
2. On-chip system integrated metamaterial based polarimeter: We will demonstrate a standalone compact and fast multifunctional polarimeter module integrated with detector arrays for single-shot fast wavelength-resolved polarization analysis. Commercial polarimeter and spectroscopic implementations are typically bulky.

3. Data processing through machine/deep learning: The alterations of the polarization associated with tissue cancerous malformations will be explored for the use as diagnostic markers by utilizing supervised Machine Learning and Deep Learning. Currently diagnostic techniques for tissue typically require manual microscopy investigation by skilled medical personnel (e.g. biopsy).

4. Enabling portable stand-alone digital histopathology system for medical diagnostics. The abovementioned objectives will be combined to transfer the state-of-the-art bench-top digital histopathology system developed in ATTRACT Phase 1 to a stand-alone hand-

held system developed at TRL 6. This system will be based on the above-mentioned state of the art metamaterial components which can be dramatically miniaturized.

The prototype system of objective 4 system will be demonstrated at TRL 6 by testing the system on realistic tissue phantoms and paraffin embedded tissue blocks, and benchmarking with the latest version of the tabletop system developed in ATTRACT Phase 1. The adaptive and multifunctional metamaterial components from objectives 1 and 2 will be benchmarked against relevant parameters from commercially available components.

© Copyright ATTRACT

All rights, amongst which the copyright, on the materials described in this document rest with the original authors of the text, except where referenced. Without prior permission in writing from the authors and the Fundación Esade, this document may not be used, in whole or in part, for the lodging of claims, for conducting proceedings, for publicity and/or for the benefit or acquisition in a more general sense.

Legal Disclaimer

The European Commission's support does not constitute an endorsement of the contents, which only reflect the views of the author. The Commission is not responsible for any use of the information contained therein.

This project has received funding from the European Union's Horizon 2020 research and innovative programme under grant agreement No. 101004462