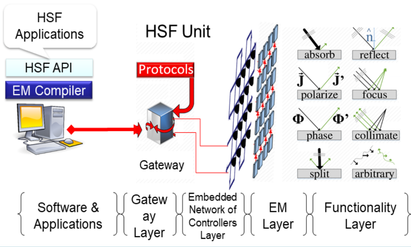
University of Cyprus
Department of Computer Science

What if EM waves could be manipulated by software- opening a whole new world of applications, from mobile comms to medical to military, or even tracing viruses?

VisorSurf a FETOPEN project, whose objective is to develop a full stack of hardware and software components for smart, interconnected planar objects with programmable electromagnetic behavior, is addressing this.

The key-enablers are the metasurfaces, engineered materials whose electromagnetic properties depend on their internal structure. HyperSurfaces realise software controlled metasurfases by merging them with embedded networked electronic control elements and a well-defined software programming interface and application specific tools.

"Customized propagation of electromagnetic emissions for novel applications such as wireless communication, power transfer and security"



Our News

Project meeting in Crete, where VisorSurf partners gathered to show their latest works, exchange ideas and plan ahead.

Participation of VisorSurf in the Researcher's night **science fare** in Nicosia 2019.

A patent on the ''A New Wireless Communication Paradigm: Realizing Programmable Wireless Environments Through Software-Controlled Metasurfaces'' was applied for in the US and in EU. The US patent was granted (28 January 2020 under No. 10,547,116), whilst the EU applied patent is still pending final granting (European Patent application Publication on 06.02.2019 Bulletin 2019/06, Reference No. EPA-143-960).

Summer interns have joined the project for the summer of 2020. They are assigned tasks in formal analysis, routing and emulator-based testing.

European Innovation Council: State-of-the-art programmable 'plug-and-play' hypersurface from VisorSurf allows integration into novel applications, without prior knowledge of the physics involved [learn more].

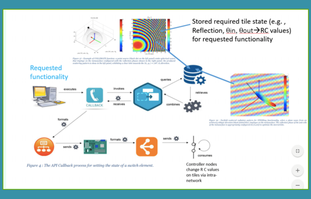
Publications

The CS group at UCY, in collaboration with project partners, has published the following in the period 2017-2020

- **8** Journal papers.
- **17** Conference papers.
- **2** Posters

The VISORSURF consortium is conducting cutting-edge interdisciplinary research in:

- Analysis, design, implementation and evaluation of metasurfaces
- Advanced, massive packaging and integration of electronics
- The novel inter- and intra-networking capabilities provided by Hypersurfaces
- Metasurface-Specific Integrated Circuit design
- Theoretical performance bounds and scalability analysis of existing and future technologies – such as nanonetworked control agents – for building Hypersurface
- Applications of Hypersurfaces, such as the Programmable Wireless Environments which promise customized propagation of electromagnetic emissions for advanced wireless performance, power transfer and security



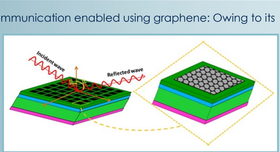
Programmable Wireless Environment envision planar objects such as walls in a floorplan to receive a special coating that can sense impinging waves and actively modify them by applying an electromagnetic (EM) function. Examples include altering the wave's direction, power, polarization and phase. Our approach adopts the Hypersurface (HSF) architecture to provide highly efficient and dynamically adaptable EM functions, even in the near field, through a software programming interface (API) and an EM compiler. The API allows getting the HyperSurface state and setting its EM function, while abstracting the underlying physics. The EM compiler translates API callbacks to corresponding active element states [Read more].

Selected Topics

HSF Emulator: is an experimental setup which aims to emulate the HyperSurface device using a network of Raspberry Pis. The various modules (user device, Gateways, controller nodes network) are tested and evaluated in accordance to the specifications of the HSF prototype. Furthermore, the developed routing algorithms are tested and evaluated on the emulator for experimental results **[Read more]**.

Fault Identification Protocol: Fault identification (FI) and fault tolerance (FT) are essential to ensure reliable operation of any network, which is also the case for the controller network embedded in the HSF. However, the uniqueness of the considered Manhattan-like topology and the constrains of the nano-controllers renders existing Network-on-Chip protocols unsuitable. Thus, we developed novel FI and FT techniques to serve the requirements of the HSF paradigm. Our proposed FI protocol is used to detect faulty/non-responsive controllers. Specifically, based on a timeout the algorithm locates the faulty controller and takes remedial actions (using roadblocks) to ensure uninterruptable operation of the HSF **[Read more]**.

THz communication enabled using graphene: : THz communication enabled using graphene: Owing to its unique electronic and plasmonic properties at THz frequencies, graphene based device enables high miniaturization and reconfiguration. Graphene plasmons possess more confinement, low loss and good tunability. The strong optical response arising from graphene surface plasmons also enables novel metamaterial. Because of its two-dimensional nature and support of surface plasmon polariton at THz, graphene has become a promising candidate for novel THz Metasurface **[Read more]**.



More about VisorSurf

Part of these activities is in collaboration with the "Real-time Control of the Wireless Behavior of Environments with HyperSurfaces" HSADAPT project (Cyprus Research & Innovation Foundation: COMPLEMENTARY/0916/0008)

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