PhD position in LiDAR imaging with Metasurfaces
Centre de Recherche sur l'hétéro-épitaxie et ses applications, France

Title: ''Real-time and Full-frame depth imaging with metasurface based LiDAR system''
Supervisor: Dr. Patrice Genevet
Start Date: October 2020-March 2021
Duration: 3 years.
Keywords: Metamaterials, Metasurfaces, LiDAR, flat optics.

A PhD position is available in relation with an existing project initiated by the European research council proof of concept (ERC PoC) program "Light Detection and ranging with metasurfaces". The position will be based at the "Centre de recherche sur l'hétéro-épitaxie et ses applications", in the group of Dr. Patrice Genevet.

We are looking for a talented and passion-driven candidate for a PhD scholarship at the Centre de Recherche sur l'Hétéro-Epitaxies et ses Applications (CRHEA @ www.crhea.cnrs.fr), University Côte d'Azur, France.

Description: LiDAR is the acronym for an imaging technique called Light Detection and Ranging. It is a well-known surveying method that emerged after the development of its older sister, the RADAR (Radio Detection And Ranging). The method, which utilizes a pulsed light source to illuminate targets, is capable of detecting the reflected light pulses with a sensor in order to calculate the distance of various object in a 3D scene. This is commonly achieved by scanning the laser beam at different angular positions. **To date, most LiDAR schemes rely on the utilization of light sources mounted on mechanically rotating** multiple

Low-imaging frame rate of current LiDAR systems seriously restrains usability and applicability. New approaches, enabling highly detailed images at high speed for making timely reactions, thus avoiding constant manual check for correcting imaging errors and perception mistakes in real time, still have to be developed.

optical transmitters and receivers to illuminate the entire scene. These devices have been used, for example, on self-driven cars and various systems requiring fast imaging and ranging of moving objects in their surrounding environments. Unfortunately, the current technology **suffers from various limitations** including **cost**, **footprints**, **long-term reliability of the mechanical components** and other moving parts, **and -probably the most stringent limitation- is the limited imaging rate**. The latter is essentially given by the rotation speed of mechanical components, thus limiting speed and resolutions, as depicted in Fig1.

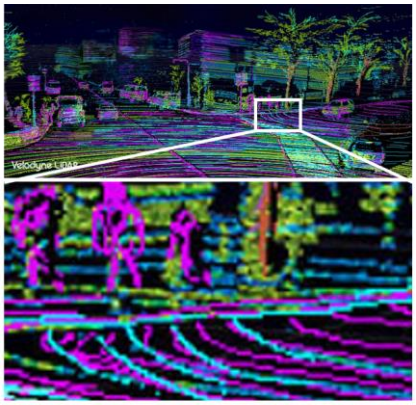

Fig1: Low resolution LiDAR image (from Velodyne Lidar)

Relying on the performance of newly developped Metasurfaces for arbitrary light shaping, the student will be responsible for setting up this new type of **high-speed LiDAR system**.

Beyond the utilization of high speed LiDAR systems in self-driven cars, this technology could find various academic and civil applications. One can easily foresee the realization of ultrafast light scanners for biological imaging, for the realization of new generation of beam steering devices for virtual/augmented reality displays and for high – speed target detection and tracking and eventually larger devices such as theatre projectors. All these applications make the suggested research path highly attractive.

How to apply and eligibility:

To enter our PhD programme applicants a Master qualification of equal or higher standard, in Physics, Engineering or a related discipline (or equivalent international degree). For further information please contact **Dr. Patrice Genevet** (CNRS-CRHEA, pg@crhea.cnrs.fr) or visit the group website http://2dphotonics.weebly.com/ .

References:

[1] "*Metasurface-integrated Vertical Cavity Surface-Emitting Lasers for programmable directional lasing emissions*" Y.Y Xie, P.N. Ni, Q.H. Wang, Q. Kan, G. Briere, P.P. Chen, Z.Z. Zhao, A. Delga, H.D. Chen, C. Xu, and P. Genevet , **Nature nanotechnology,** (Jan. 2020), doi:10.1038/s41565-019-0611-y See : https://physicsworld.com/a/metasurfaces-help-shape-laser-beams/

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[3] "*Metasurface Orbital Angular Momentum Holography*" H. Ren, G. Briere, X. Fang, P. Ni, R. Sawant, S. Héron, S. Chenot, S. Vézian, B. Damilano, V. Brändli, S. A. Maier, and P. Genevet, **Nature Communications**, 10, 2986 (2019)

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