# Measurement of microwave meta-quaternion vortex arrays enabling imaging encryption

Jicheng Wang*, Sen Feng, and Jing Hong

*School of Science, Jiangnan University, Wuxi 214122, China*
*Email address: jcwang@jiangnan.edu.cn

**Abstract:** Electromagnetic metasurfaces exhibit considerable potential for generating high-purity vortex beams and enabling high-resolution imaging and information encryption. However, traditional microwave devices face challenges, including reduced efficiency due to bulky size and material losses. Herein, we designed a multi-layer structure and demonstrated through simulations that this configuration served as an efficient transmissive meta-atom. Careful optimization of the structural dimensions resulted in a high transmittance at the operating frequency. We further reduced the array size and finally determined that the optimal minimal unit was the meta-quaternion vortex array, which was subsequently used as the pixel basis for the target image. A digitally patterned metadevice was fabricated and experimentally characterized with right-handed circularly polarized (RCP) light. The experimental results were in excellent agreement with the simulations. Herein, we combined the classical nine-grid encryption method with panels of alphabetic and numeric arrays and introduced the weighted superposition computation technique to achieve multi-layer encryption of target characters.

**References:**

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**Prof. Jicheng Wang** is currently the professor of the School of Science, Jiangnan University. He has published/co-published over 190 journal paper. He is also a co-inventor in 20 patents related to nanophotonics and photodetectors. His research interests include micro and nano optics, nano photonics, metamaterial and metasurface, topological optics, optical modulation, nanostructured optoelectronic devices.