Transformation and Phase Retrieval of Electromagnetic Fields between a Plane and an Arbitrary Surface Using Machine Learning

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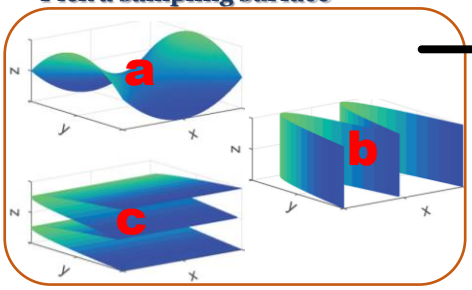
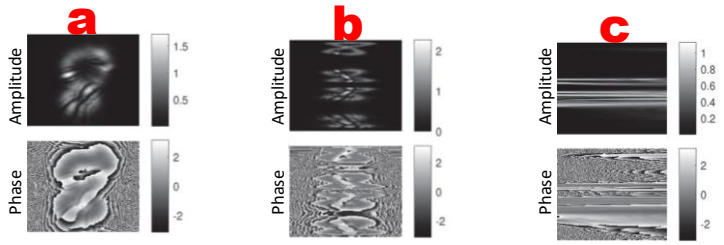
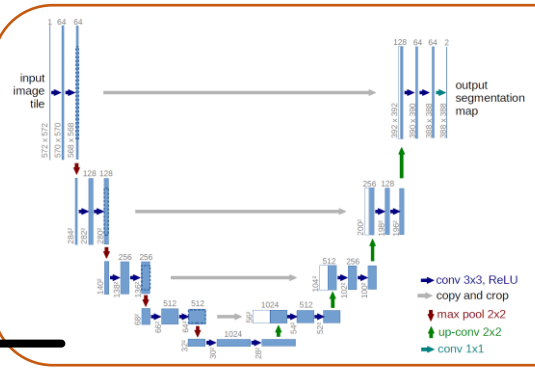
The ability to tailor a specific electromagnetic field pattern along an arbitrary selected surface is interesting and of substantial importance, given its numerous immediate applications. It belongs to a class of inverse source problems, and, as such, it is particularly challenging when only partial data are given. Here, a deep learning-based method that is able to map the electromagnetic field from an arbitrarily selected surface to a flat surface is presented. This method is used to realize, experimentally, arbitrary target field patterns on an arbitrary concave surface facing a source field on a flat programmable optical element. In addition, phase retrieval capability is demonstrated for finding both the phase and amplitude on an input flat surface from knowing only the amplitude on an arbitrarily selected surface.

Pick a sampling surface



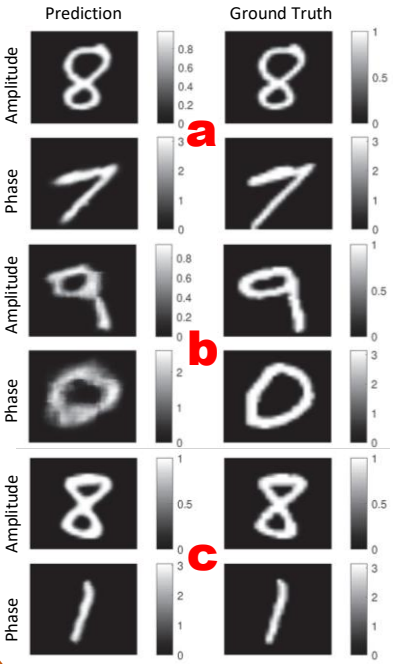
Pick both the Phase and Amplitude in space



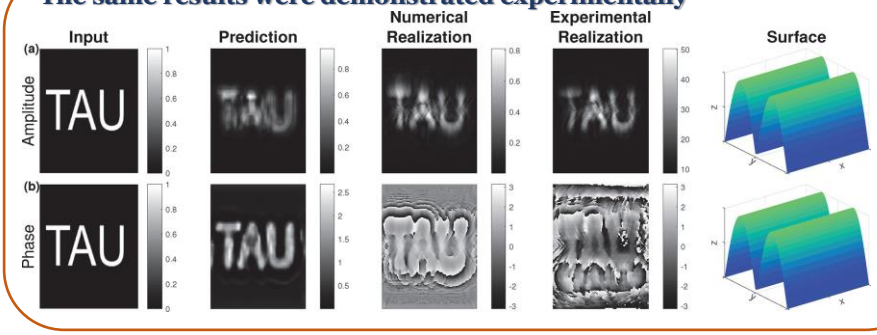


An adjusted U-NET architecture reconstructs the phase and amplitude from the sampled surface

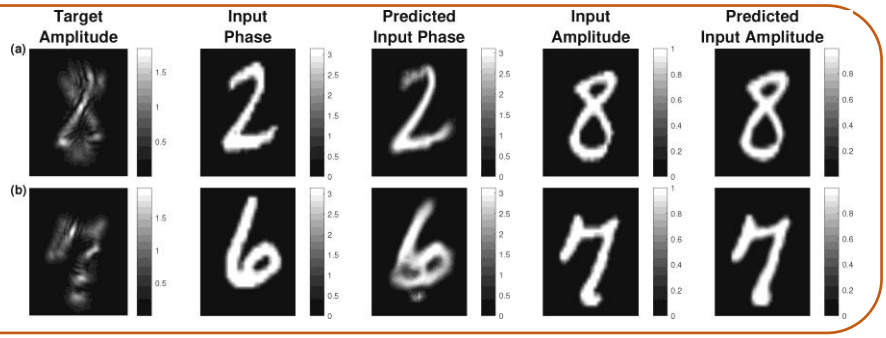
Predicted phase and amplitude on the input surface compared with the ground truth



The same results were demonstrated experimentally



Phase and amplitude retrieval for the field on the input surface from the amplitude on target surface - a



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