Università degli Studi di Messina
Dottorato di Ricerca in Fisica

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&
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Structuring light with extreme metamaterials

Nader Engheta
(University of Pennsylvania, Philadelphia, USA)

Materials are often used to manipulate waves. Metamaterials have provided far-reaching possibilities in achieving "extremes" in such wave-matter interaction. Various exciting functionalities have been achieved in exploiting metamaterials and metasurfaces in nanophotonics and nano-optics. We have been exploring how extreme metamaterials can give us new platforms in metaphotonics for exploiting waves to do certain useful functions for us. Several research topics are being investigated in my group. In one of these programs, we have been developing metastructure platforms that can perform analog computation such as solving integral and differential equations and inverting matrices with waves as waves interact with them. Such "metamaterial machines" can function as wave-based, near-speed-of-light analog computing machines, suitable for micro- and nanoscale integration. Another research program is the near-zero-index (NZI) media in which the effective relative permittivity and/or relative permeability can attain near-zero values around the operating frequencies of interest. In such NZI structures, effective wavelength "stretches", and consequently numerous unprecedented wave phenomena emerge. In this talk, I will present some of our ongoing work on extreme material platforms for metaphotonics, and will forecast possible future research directions in these paradigms.

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