Mathias Fink

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Mathias Fink is the George Charpak Professor at the Ecole Superieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI Paris) where he founded In 1990 the Laboratory "Ondes et Acoustique" that became in 2009 the Langevin Institute. He is member of the French Academy of Science and of the National Academy of Technologies of France. In 2008, he was elected at the College de France on the Chair of Technological Innovation. He has received several scientific awards as the CNRS Medal of innovation, the Helmholtz-Rayleigh Award of the Acoustical Society of America, the Rayleigh Award of the IEEE Ultrasonics Society and the Edwin H. Land Medal of the Optical Society of America

Mathias Fink's area of research is concerned with the propagation of waves in complex media and the development of numerous instruments based on this basic research. His current research interests include wave control in complex media, time-reversal in physics, metamaterials, telecommunications, super-resolution, medical ultrasonic imaging, multiwave imaging. 6 start-up companies with more than 400 employees have been created from his research (Echosens, Sensitive Object, Supersonic Imagine, Time Reversal Communications, CardiaWave and Greenerwave).

Abstract

In this talk, I will show how the work performed at Langevin Institute on wave control have led to the seminal concept behind large reconfigurable intelligent surfaces (RIS) that is currently a topic of great interest in the wireless communication community.

Starting with the first demonstrations of ultrasonic "time-reversal mirrors" focusing in complex media in the early nineties, I will underline how these ideas were first used for underwater acoustic communications and were transposed later, for electromagnetic waves, into the concept of massive MIMO to optimize channel diversity.

Compared to these techniques that need multiple antenna array, I will explain how we proposed, ten years ago, another approach using tunable metasurfaces to obtain with a limited number of transmitters the best communication performance. The main idea is to replace the numerous transmitting antennas by a smart modification of the wireless environment by physically shaping the propagation medium to achieve optimal focusing and channel diversity. I will show how the optimization of these metasurfaces results from the generalization of the "time reversal mirror" concept to the one of the products of different time-reversal mirrors associated with each transmitters and receivers.