SHORT COURSE ON TIME REVERSAL ACOUSTICS

INTRODUCTION

An acoustic Time Reversal Mirror (TRM) refocuses an incident acoustic field to the position of the original source regardless of the complexity of the medium between this "probe" source and the TRM. TRM's have now been implemented in a variety of physical scenarios from MHz ultrasonics with order centimeter aperture size to hundreds/thousands of Hz in ocean acoustics with order hundred meter aperture size. Common to this broad range of scales is a remarkable robustness exemplified by observations at all scales that the more complex the medium between the probe source and the TRM, the sharper the focus. The potential for applications in many areas of acoustics is quite high.

OBJECTIVE

To provide the acoustical physics overview and description of the experimental implementation of time reversal and phase conjugate processes as related to ultrasonics and imaging, nondestructive testing, medical ultrasonics, propagation in random media, room acoustics, waveguides, and ocean acoustics.

Mathias Fink received the M.S. degree in mathematics from Paris University, France, in 1967, and the Ph.D. degree in solid state physics in 1970. Then he moved to medical imaging and received the Doctorat es-Sciences degree in 1978 from Paris University. His Doctorat es-Sciences research was in the area of ultrasonic focusing with transducer arrays for real-time medical imaging.
Dr. Fink is a professor of physics at the Ecole Superieure de Physique et de Chimie Industrielles de la Ville de Paris (ESPCI), Paris, France, and at Paris 7 University (Denis Diderot), France. In 1990 he founded the Laboratory Ondes et Acoustique at ESPCI. In 2002, he was elected at the French Academy of Engineering, in 2003 at the French Academy of Science and in 2008 at the College de France on the Chair of Technological Innovation.- Liliane Bettencourt.
His current research interests include medical ultrasonic imaging, ultrasonic therapy, nondestructive testing, underwater acoustics,
telecommunications, seismology, active control of sound and vibration, analogies between optics, quantum mechanics and acoustics, wave coherence in multiply scattering media, and time-reversal in physics.
He has developed different techniques in acoustic imaging (transient elastography, supersonic shear imaging), wave focusing in inhomogeneous media (time-reversal mirrors), speckle reduction, and in ultrasonic laser generation. He holds more than 40 patents, and he has published more than 300 articles. 4 start-up companies have been created from his research (Echosens, Sensitive Object, Supersonic Imagine and Time Reversal Communications)