

Time Reversal: From Acoustics to Electromagnetism

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Time-reversal invariance is a very powerful concept in classical and quantum mechanics. In the field of acoustics and electromagnetism, where time reversal invariance also occurs, time-reversal experiments may be achieved simply with arrays of transmit-receive antenna, allowing an incident wave field to be sampled, recorded, time-reversed and re-emitted.

Time reversal mirrors (TRMs) may be used to study random media and complex reverberating structures. Common to these complex media is a remarkable robustness exemplified by observations that the more complex the medium between the probe source and the TRM, the sharper the focus. This property is related to the fact that TRMs work with broadband signals, contrary to phase conjugated mirrors. TRMs open the way to new signal processing's that interest imaging, detection and telecommunications.

Due to the limited frequency range of acoustics waves (KHz and MHz), TRMs have been first developed in this field of Acoustics. They have plenty of applications including ultrasonic therapy, medical imaging, non destructive testing, telecommunications, underwater acoustics, seismology, sound control and domotics. An overview of these fields will be presented.

Time reversal within the GHz range is now possible and it is now applied with Electromagnetic waves. A comparison of the TRM possibilities in Acoustics and Electromagnetism will be discussed.