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Laser Impulse Transfer and Real-Time Target (Re-) Alignment Systems

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Laser irradiation with various materials has plenty of technical and technological applications, from CD players and material processing (cutting drilling and so on) to medical applications. There are special cases when the laser beam needs to target a precisely determined zone or the target needs to be in a rather narrow laser focus zone, and laser driven particle acceleration it is just one of the examples when the beam alignment becomes a critical issue. If the target is not rigidly fixed or moves (oscillate or 'shakes'), then the difficulty of the targeting and respectively focusing operation further increases.

Based on impulse transfer measurements on thin metallic targets and respectively target (predictable) movement, the aim of this paper is to present an implementation of multidimensional laser targeting system for a moving target along with the laser triggering system based on the trajectory prediction. The current experimental setup involves 1 basic movement in polar coordinates (respectively 1 oscillation) while target position data acquisition is based on an alignment laser and a fast CCD camera for the movement detection in 3D coordinates. Computer modelling software is based on a template matching algorithm and a predictive algorithm for target motion based on Prony's Method.

The experimental setup and results are presented for 1D (polar coordinates) case and further extended for the a generic 3D case. The 'targeting'performances are shown with respect on the main spatial and temporal performances, while some applications in high-power laser interactions are also discussed.

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