Pulse dynamics in transformed plates

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Transformation media, a now well-established geometric concept introduced to manipulate wavefields and design systems with new functionalities, has been mostly investigated with monochromatic waves. The most known is cloaking, which has been achieved with continuous waves, but never demonstrated for short pulse excitation. Here, we investigate pulse dynamics of flexural wave propagating in transformed plates. Using coordinate transform, the deformed space is recreated in the plane by varying the plate thickness on a sub-wavelength scale in order to introduce inhomogeneity and anisotropy. As a proof of concept, we design a waveshifter, a bent waveguide capable of steering the wave at an angle without back-reflection. Time-resolved measurements reveal that the deviated wavepacket is preserved both in time and space. A modal analysis shows how higher modes are prevented from being excited in the bent waveguide. The design concept is demonstrated experimentally in the more involved case of the rotator, a reflectionless device which is shown to successfully rotate the wavefront of the incident pulse, while preserving the pulse shape. Three dimensional full-elasticity simulations support the experimental observations, and suggest the possible realisation of a unique dynamical mirage effect, where an obstacle is seen to be oriented in a deceptive direction.