Acoustic target identification with chaos based waveforms

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We propose a method of distinguishing two known targets using their their acoustic signatures in cross correlation with selected chaos based waveforms. Initially acoustic chirp waveforms were digitally generated, broadcast from a tweeter and scattered off several similarly sized objects for a number of object orientations. A microphone aligned with the tweeter received the scattered waveforms and the waveforms were digitized with an oscilloscope. The digitized waveforms received from two distinct objects were sorted into angular windows. A computer program generated a large number of test waveforms with the same band width (20%) and center frequency (3.3 or 5 KHz) as the original chirp. Two methods both derived from chaotic time series were employed to generate the test waveforms. In one case constant amplitude waveforms were assembled from concatenated sinusoids whose periods were specified by the time series. In the other case the time series its self was run through a band pass filter. The time series were generated by taking the modulus of a six parameter chaotic map. The shift register parameters were randomly varied and the generated test waveforms were selected to maximize the averaged cross correlation of the return from one target, while minimizing the averaged cross correlation of the other and vis versa. Contrast ratios, ratios of the cross correlations, were then calculated for each target for return waveforms within each angular window. Waveforms that maximized the difference in contrast between the two targets were retained and optimized via a standard downhill simplex routine. Using these optimized waveforms we can distinguish between targets for orientations within our orientation windows.