Karlsruher Institut für Technologie

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KOLLOQUIUM

Informatik-Sonderkolloquium

Using Realistically Simulated Undersea Channels to Evaluate the Performance of Authenticating Sonar

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Undersea communication channels are filled with acoustic emissions of various kinds. From sonar to the signals used in acoustic communications, man-made noise, and biological signals generated by marine life, the ocean is a complex conduit for diverse emissions. In this talk, we discuss an algorithm in which an acoustic emission such as a sonar signal is transparently and securely embedded with signatures known as a digital watermark. Extracting the watermark helps to distinguish, for example, a friendly sonar from other acoustic emissions that may exist as part of the natural undersea environment, or from pings that may have originated from hostile forces or echoes fabricated by an adversary. We have adopted spread spectrum as an embedding technique. Spread spectrum allows for matching the watermark to propagation, multipath, and noise profiles of the channel. The sonar is first characterized by its spectrogram and divided up into non-overlapping blocks in time. Each block is individually embedded with a single bit drawn from the watermark payload. The seeds used to generate the spreading codes are the keys used by authorized receivers to recover the watermark. The detector is a maximum likelihood detector using test statistics obtained by integrating a correlation detector output over the entire sonar pulse width. Performance of the detector is controlled by signal-to-watermark ratio, specific frequency bands selected for watermarking, watermark payload, and processing gain. For validation, we use Sonar Simulation Toolset (SST). SST is a software tool that is custom-made for the simulation of undersea channels using realistic propagation properties in oceans. Probabilities of detection and false alarm rates, as well as other performance boundaries, are produced for a shallow water channel subject to multipath and additive noise.

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