MARKET SHEET

Tamper Detection Using Time-Reversal Acoustics

Sandia National Laboratories

Monitor and safeguard high-value assets such as enclosures, materials, and storage containers from tampering using time-reversed acoustic waves

US Patent Pending

Technology Readiness Level 4

Tamper-indicating technologies are used to verify the integrity of monitored items or high-value assets. As the number of monitored items increases internationally and monitored items in storage become more difficult to access, new tamper-indicating technologies and approaches are needed to increase the effectiveness of verifying the integrity of items and increase efficiency during inspections. Conventional methods for tamper event detection are limited by their non-standard shapes and sizes, high cost to secure assets in large rooms, and vulnerability to access knowledge with advanced adversarial skills. Comparatively, Time-Reversal Acoustic (TRA) does not require high-density recordings or optical imaging, is cryptographically strong and has exceptional feature size resolution of 100μm.

Time-Reversal Acoustic (TRA) uses propagation of time-reversed acoustic waves that interact with the structural features of an asset within its environment to indicate a tamper event. Sandia researchers performed numerical modeling to demonstrate the viability of time-reversal acoustics as a means of tamper detection. They successfully developed a prototype using a multi-transducer system that detected subtle component modifications on printed circuit boards in air. In addition to using TRA to detect tampering events at the room-level in air, the researchers also demonstrated tamper indication for containers stored underwater and in much harsher conditions, such as high radiation. The TRA prototype can detect tampering events and the location of the event. The cryptographic strength of this prototype has been measured to be 3300 bits per meter; TRA scales with wavelength relative to the size of the environment.

There are no other TRA devices on the market to date using this technology. Most tamper detection technologies are based on optical measurements, using videos and data processing to track changes. Those systems scale with the number of cameras and their lifetime in their environment, thus adding up to be more expensive with scale and time. Comparatively, TRA is ten times (10x) less expensive, and it can be sustainable in harsh environments as well. This transformational technology possesses a great potential to become the market leader in tamper detection for safeguarding high-value assets such as enclosures, materials, and storage containers.

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Features & Technical Benefits

- Does not require high-density recordings or optical imaging
- Cryptographic strength of 3300 bits per meter
- Exceptional feature size resolution (i.e., 100µm)
- Ideal for volumetric tamper indication in air and underwater
- Suitable for use in harsh environments, such as high radiation
- TRA is lower cost, ~ 10x less expensive

Applications & Industries

- Tamper detection
- Equipment enclosures, materials, and storage containers
- National security
- Monitoring international treaty obligations

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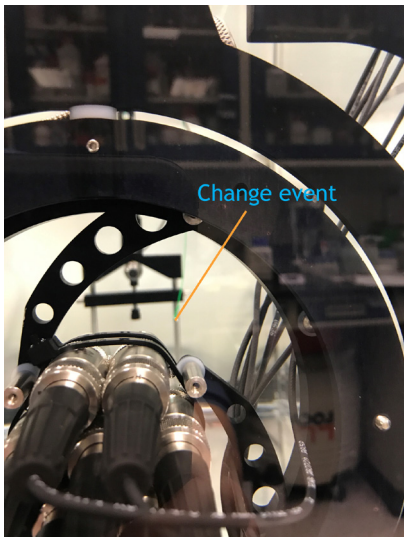
Technical Figures



TRA Method of Decoy Detection in air (Figure A at left) and water (Figure B at right). The method can detect changes around barriers and other non-line-of-sight conditions.

U.S. DEPARTMENT OF ENERGY NNSA National Nuclear Security Administration

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