Docket #: S18-123

Next Generation Explosive Detection with Differential Phase Contrast (DPC) Imaging – Artifact Removal and Automated Analysis

Stanford researchers have developed an exceptionally fast, sensitive, and compact X-ray imaging system for distinguishing liquids and other materials in aviation security applications. Whereas traditional dual-energy computed tomography (CT) systems have difficulty identifying explosive liquids or powders in security inspections, this new system uses Differential Phase Contrast (DPC) to greatly increase the contrast when imaging liquids or low-density materials. DPC provides a tri-signature derived from three independent material property measurements: standard absorption (ABS); index of refraction (DPC); and dark field scattering (VIS), to produce an image that can then be processed and analyzed for automated material identification. This DPC technology enables new inspection techniques as well as the automatic discrimination between hazardous and non-hazardous liquids and low-density powders in cluttered baggage and containers. In addition, the system has the potential to provide a 16-fold increase in speed of conventional DPC X-ray systems, as well as a substantial reduction in X-ray exposure, in comparison to current X-ray and CT techniques.

A recent development in this project is a fast, simple and effective image processing algorithm to remove X-ray DPC CT artifacts caused by sharp edges of the object being imaged. Correcting these artifacts greatly improves the accuracy of the tri-signatures in the image and enables automated material identification through machine-learning and statistical analysis. This is particularly useful in a typical baggage inspection environment, where the cluttered contents are comprised of a variety of unknown materials.

The DPC algorithm (Stanford Docket S18-123) is being licensed as a package along with the intellectual property for the system hardware:

Photo Emitter X-Ray Source Array (Stanford Docket S12-318) - the PexSA X-ray source, a method to create a patterned X-ray source that can be patterned

Enhanced Photoelectron Sources Using Electron Bombardment (Stanford Docket S13-018) - a method to provide a new means of generating pulsed X-rays by pulsing the excitation optical source

Photonic Channeled X-ray Detector Array (Stanford Docket S15-291) - the Photonic Channeled-Ray Detector Array (PcXDA) X-ray detector, that transforms an X-ray pattern into a visible wavelength optical pattern and eliminates an expensive analyzer grating from conventional X-ray fringe detection system

Fates: Compact, Sensitive X-ray Differential Phase Contrast Imaging System (Stanford Docket S16-173) - an architecture that replaces the standard 3-grating system with a single grating

Applications

- **Industrial X-ray inspection**
    - aviation security - baggage imaging for DHS applications
    - container inspection
    - non-destructive testing
- **Medical imaging**

Advantages

- Compact hardware
- Sensitive - wide field of view with high resolution and contrast to distinguish between hazardous and non-hazardous materials
- Image correction with no *a priori* knowledge of what the materials are
- Relatively inexpensive lasers
- Potential for 16-fold improvement in screening speed over conventional DPC X-ray systems

Patents

- Issued: 11,113,851 (USA)

Innovators

- Ching-wei Chang
- Lambertus Hesselink

Licensing Contact

David Mallin

Licensing Manager, Physical Sciences

Email