Challenges In Air Cargo Screening

Daniel Goh
Recap of Air Cargo Screening

Air Cargo Screening Regime

Consolidated Air Cargo Screening
– FINDEX Air Cargo Scanner

Break Bulk Air Cargo Screening
– CT Based Inspection System
Part One

Recap of Air Cargo Screening
Air Cargo Screening as part of Aircraft Security

Part 1

Part 2

Part 3

Part 4

Passenger & Luggage Security

Checked Luggage Security

Air Cargo Security
Air Cargo constitutes 30% of international trade

Only a small fraction of global air cargo is actually screened

Screening practices vary widely

Highly variable: non-homogenous, cluttered contents and differing shipment size
The Threats in Air Cargo Screening

- Explosives
- Flammable Substances
- Arms and Ammunitions
- Nuclear Materials
- Narcotics
- Tobacco
- Alcohol
- Quarantine items

- <1 Litre / 1 m³
- <1 kg / 1 ton
The screening technology and methodology need to be:

- Safe and Reliable
- Capable of detecting desired threats
- Easy to operate and maintain
- Compatible with current and future operation
Part Two

Air Cargo Screening Regime
Break Bulk Cargo Screening

Break Bulk Cargo Inspection lines

1. CT Inspection System
2. X-ray Inspection System
3. Control Center
4. Raman/CT Technology Liquid Scanner
Other recheck methods: ETD, Radioactive Monitoring System, etc.
Consolidated Cargo Screening

Air Container

FINDEX Air Cargo Scanner

Palletized Cargo

Conventional Large Pallet X-ray Inspection System
Vehicle Screening

PB Series Cargo/Vehicle Inspection System

Multifunction Fast-Scan System

MT Series Mobile System
Challenges in Air Cargo Security

- Consolidated cargo is hard to screen
- Break Bulk cargo screening is time consuming and laborious
- Time pressure - must not impede logistic flow and airplane schedule
- Existing technologies face limitations – high cost, low speed, cannot distinguish within clutter
Part Three

Consolidated Air Cargo Screening

FINDEX Air Cargo Scanner
Challenges in Air Cargo Security
Consolidated Cargo Screening

- Screening of built-up ULD/Pallet
- High energy X-ray scanner is used
- Scan before loading onto aircraft
- Time efficiency: cargo already consolidated
- Lower labour cost
**FINDEX Technology and Its Benefits**

**Fast Interlaced Neutron and Dual-Energy X-ray imaging technology**

- Utilizes high resolution X-ray radiographic image
- X-ray data provides information about density of material
- Neutron/X-ray interaction cross-section ratio provides information about the average composition of the material
- More sensitive than dual-energy X-ray technology
FINDEX Technology and Its Benefits

Transmission

\[ \frac{I^x}{I_0^x} = e^{-\mu_x \rho x}, \quad \frac{I^n}{I_0^n} = e^{-\mu_n \rho x} \]

Composition

\[ R = \frac{\frac{\mu_n}{\mu_x} = \frac{\ln(I^n/I_0^n)}{\ln(I^x/I_0^x)} } \]

Graph showing R-value vs. Material:
- Material: Polythene, C, Al, Fe, Pb, U
- R-value: 0.2 to 2

Graph showing Dual high-energy X-ray R-values:
- R-value: 0.0 to 1.8
FINDEX Technology and Its Benefits

- More precise material discrimination capability based on material composition and density
- Particularly high sensitivity to organic materials, such as concealed explosives and narcotics
Part 2

- 14 MeV D-T neutron generator and 6/3 MeV dual energy X-ray accelerator
- Plastic scintillator X-ray and neutron detector
- Compact design-patented fast neutron shielding technology
- No on-site construction work
- Easy maintenance
<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Source</td>
<td>X-ray: Interlaced Dual-energy Electron Linear Accelerator</td>
</tr>
<tr>
<td></td>
<td>Neutron: 14MeV Thermo Fisher generator</td>
</tr>
<tr>
<td>Penetration</td>
<td>320mm steel</td>
</tr>
<tr>
<td>Max Size of Scanned Object</td>
<td>2.44m (Width) × 3.0m (Height)</td>
</tr>
<tr>
<td>Max Weight of Scanned object</td>
<td>7000kg</td>
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<tr>
<td>Throughput</td>
<td>40 units of standard AKE/LD3 per hour</td>
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<tr>
<td>Material Discrimination</td>
<td>256 color-coded image</td>
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</tbody>
</table>
Installations

Abu Dhabi International Airport

Beijing Capital International Airport
Explosive & Contraband

- Grenade
- Pistol
- Rifle
- Explosive

Images
Part Four

Break Bulk Air Cargo Screening

CT Based Inspection System
Air Cargo Inspection by CT Scanners

- **Automated detection** for explosives, narcotics, quarantine items, etc.
- Higher supervision efficiency
- Up to 1800 parcels per hour
- Real-time On-screen Resolution
- High resolution images display
- Dual-energy material discrimination
- Improve resolution efficiency
- Image retrieval for secondary inspection
- Secondary inspection with Raman, CT liquid scanner, ETD, etc.
CT Reconstruction Principle
3D Images – Clear View of Inner Structure
High-resolution dual-energy 3D image & CT slice image

Material discrimination in 3D image to improve the image analysis efficiency.
Dual-energy CT technology – Improves recognition accuracy
Automatic Detection of Explosives
ECAC EDS Standard 3 approved

High-resolution 2D image
CT slice image
High-resolution 3D image

The ECAC EDS Std. 3 approved models:
XT2080, XT2080AD, XT2100
Installations

Part 1

Part 2

Part 3

Part 4

Liquid Explosive

Narcotics

Lithium Battery
CT Product Series

**XT2080AD**
- Tunnel Width: 750mm
- Conveyor Speed: 0.24m/s
- Throughput: 860BPH
- High-resolution, dual-energy CT slice images and 3-D images
- Certification: CAAC, ECAC EDS Std. 3

**XT2100**
- Tunnel Width: 1004mm
- Conveyor Speed: 0.3m/s
- Throughput: 1080BPH
- High-resolution, dual-energy CT slice images and 3-D images
- Certification: CAAC, ECAC EDS Std. 3

**XT2100HS**
- Tunnel Width: 1004mm
- Conveyor Speed: 0.5m/s
- Throughput: 1800BPH
- High-resolution, dual-energy CT slice images and 3-D images
- Dual-view DR images
<table>
<thead>
<tr>
<th>Consolidated (FINDEX)</th>
<th>Break Bulk (CT)</th>
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<tbody>
<tr>
<td>• Time efficiency</td>
<td>• High Throughput</td>
</tr>
<tr>
<td>• Lower labor cost</td>
<td>• Automatic threat detection</td>
</tr>
<tr>
<td>• Combo technology – Neutron + X-ray</td>
<td>• 3D reconstruction improves image analysis</td>
</tr>
<tr>
<td>• More detailed material discrimination</td>
<td>• Smaller operating area required</td>
</tr>
<tr>
<td>• Customizable threats detection: SNM</td>
<td>• Customizable threats detection: lithium battery, flammable</td>
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