U.S. Customs and Border Protection

Agriculture Programs and Trade Liaison

Agriculture Non-Intrusive Inspection in CBP Ports of Entry: Capability Requirements

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U.S. Customs and Border Protection

Field Operations

CBP's Agriculture Mission

Protect the border by preventing the entry of threats to American agriculture and natural resources

Agro/Bio-Terrorism Countermeasures Mission - Prevent tools of agro/bio-terrorism from entering the U.S.

Global Biothreat Landscape:

- 1,500 animal and human infectious diseases
- > 200 quarantine significant plant pests

High risk pathways (high volume & time constraints):

- Passenger
- International Mail

Problem needing solutions:

- Non-intrusive detection of biologicals in passenger baggage and international mail

CBP Ports of Entry Profile

- **Total U.S. Ports of Entry – 328**
- **Pre-Clearance Locations – 16**
- **Express Consignment – 25**
- **International Mail – 6**

- **Total CBPAS ~ 2,417**
- **POE staffed by CBPAS - 182**

Small-scale x-ray systems:
- **Single view**
- **Dual view**

Pre-clearance in Canada

Calgary	AB
Mississauga	ON
Montreal	QC
Ottawa	ON
Toronto	ON
Victoria	BC

NII Biodetection in Passenger Baggage

Significance of x-ray equipment:

- Only potential biodetection tool available at ports of entry
- Non-intrusive inspection of potentially biohazardous materials

Caveat:

Anomaly detection highly dependent on the operator's technical skills, experience, and discretionary ability

AQI in PAX Baggage - Workflow

1. **Travelers arrived and funneled to primary lane for admissibility**

2. {*Based on totality of circumstance*} **Traveler referred to agriculture secondary, baggage loaded on the conveyor belt.**

3. **Baggage is x-rayed**

4. **Image anomalies warrant physical inspection**

On a typical day in FY2017,

- ❑ **Total # travelers – 1,088,300**
  - **326,723 air PAX & crew**
  - **688,757 land border pedestrians**
- ❑ **Total # QMIs – 4,638**

AQI in Mail - Workflow

On a typical day in FY2017 (NY/NJ IMF),

- ❑ **Total # EC parcels ~ 468,000**
- ❑ **Total # USPS parcels ~ 950,000**
- ❑ **Total parcels x-rayed ~ 2% inbound parcels**
- ❑ **Total Ag. Inspection ~ 3% inbound parcels**
- ❑ **Total # QMIs – 78**

X-ray {Selected high−risk parcels

100% Radiation Check

On a typical day in FY2017 (SFO IMF),

- ❑ **Total # USPS parcels ~ 61,785**
- ❑ **Total parcels x-rayed ~ 6.8% inbound parcels**
- ❑ **Total Ag. Inspection ~ 4% parcels x-rayed**
- ❑ **Total # QMIs – 34**

High-risk Interceptions and Potential Carriers of Infectious Diseases

Meat & Meat Products
(Passenger, ECCF, IM)
- ***Vector of 1,5000 animal and human diseases***

Bushmeat
(Passenger, ECCF)
- ***Vectors of hemorrhagic fever virus***

Biological Products
(Passenger, ECCF, IM)
- ***Botox, plasmids, vaccines, microbial culture***

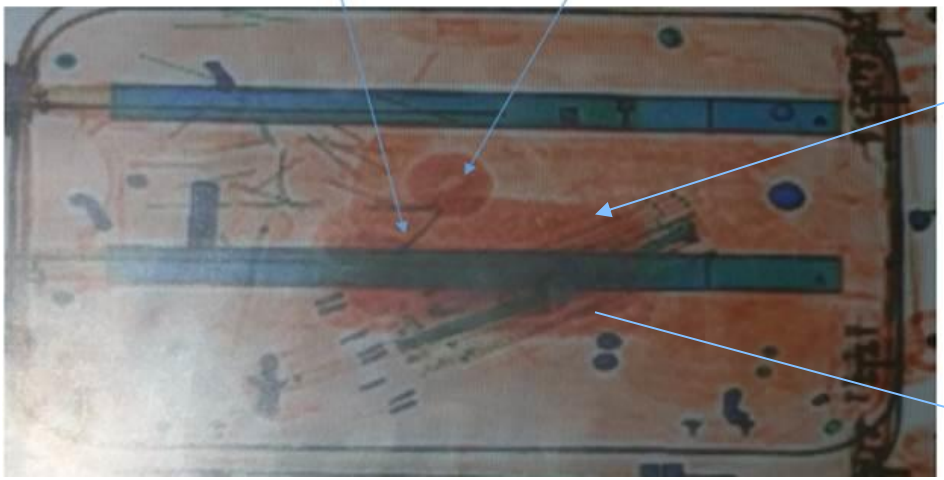
Live birds
(Passenger)
- ***Vectors of HPAI, ND***

Hatching eggs
(Passenger, ECCF)

Trophies
(Passenger)
- ***Vector of 1,5000 animal and human diseases***

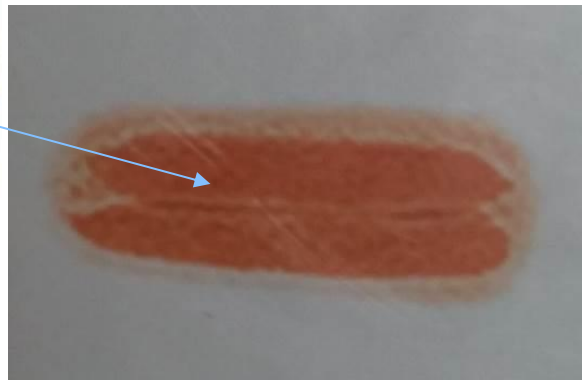
Challenges in Non-Intrusive Inspection

- **Overlap in passenger baggage**



(top view)

Coffee beans

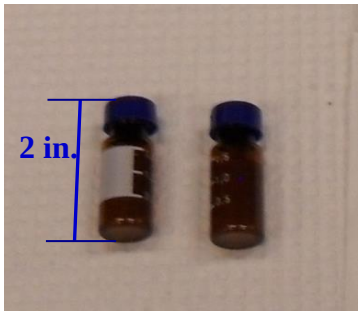


Sausage

❖ Requires better density and organic differentiation

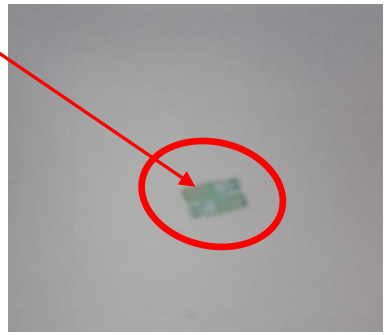
Challenges in Non-Intrusive Inspection

- **Varying x-ray resolution and differentiation capability**

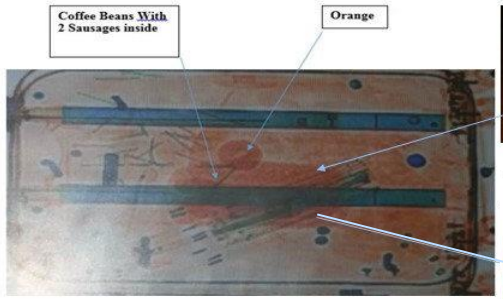


Glass vials with organic material

X-ray: Brand C Model A

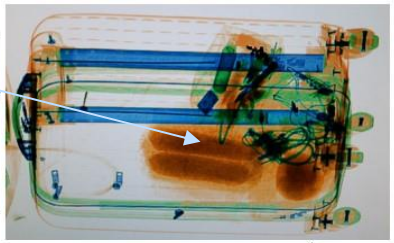


X-ray: Brand D Model B



X-ray: Brand X Model A
(top view)

Coffee beans

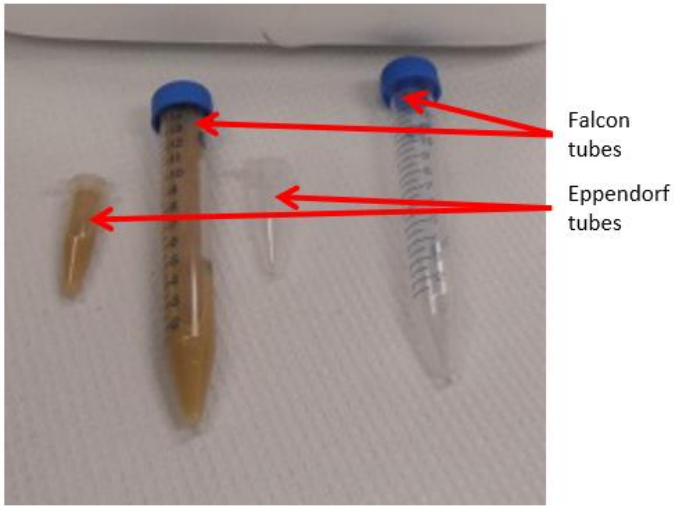


X-ray: Brand Y Model B

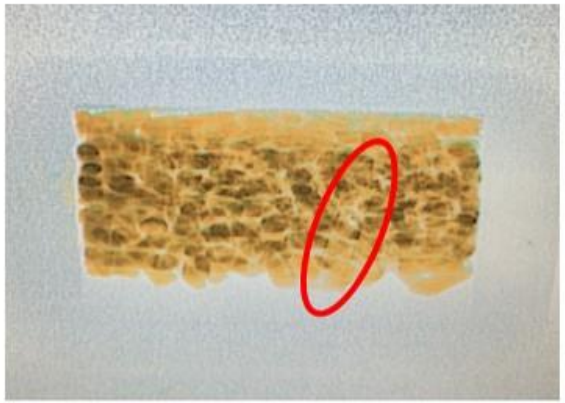
- Requires organic and inorganic enhancements

Challenges in Non-Intrusive Inspection

Ice may mask the image of biological items



Falcon tube—top view

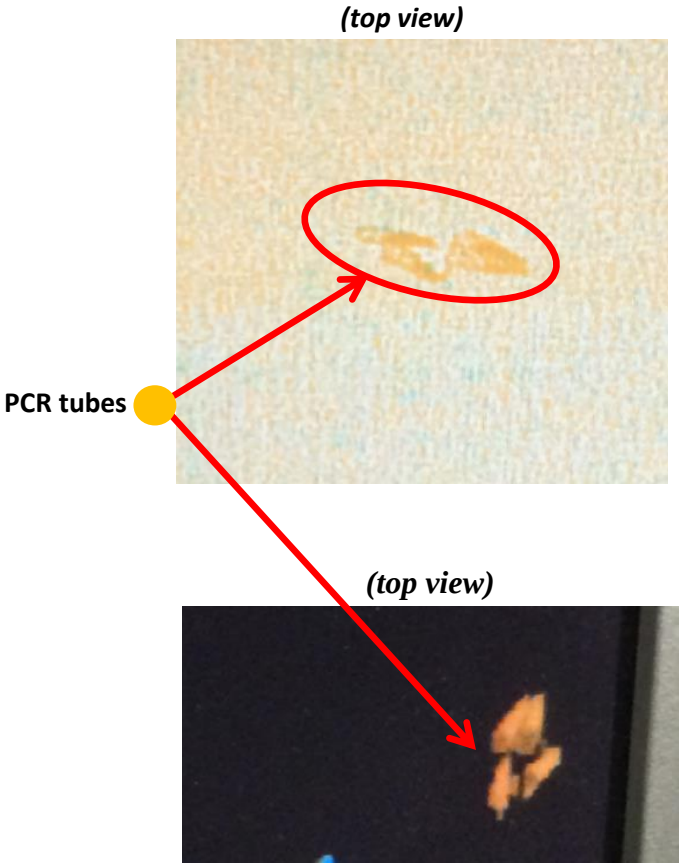


Falcon tube—side view

- **Setup:** Falcon and Eppendorf tubes with *Bacillus thuringiensis* placed in Styrofoam cooler filled with dry ice
- **Results:**
  - Dry ice will obscure plastic tubes and their contents
  - Requires a shield alarm

Challenges in Non-Intrusive Inspection

- **Biologicals are too small to draw concern**

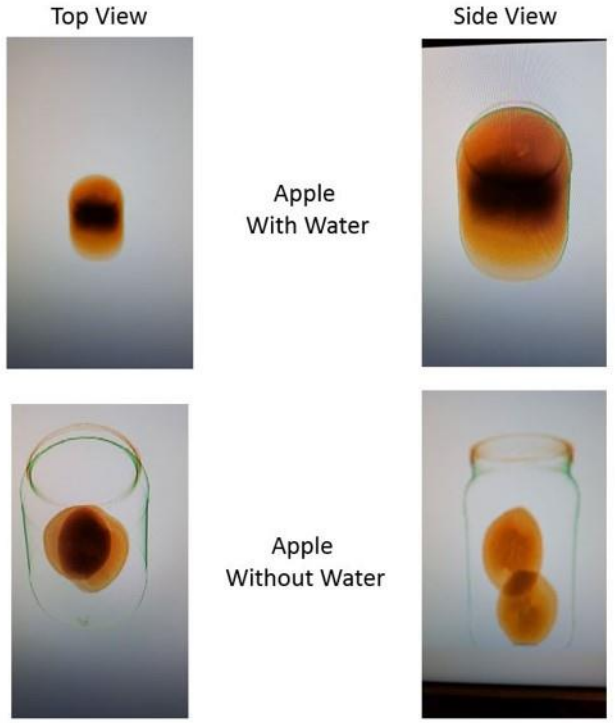


- **Setup:** PCR tubes filled with LB agar placed in envelope
- **Results:**
  - PCR tubes are visible, but resolution is poor (model variability)
  - Requires edge enhancement and zooming capability

Challenges in Non-Intrusive Inspection

Density and organic/inorganic differentiation

- **Setup:** Apples in glass with/without water
- **Results:**
  - Water masks presence of apples
  - Requires better organic and inorganic enhancements



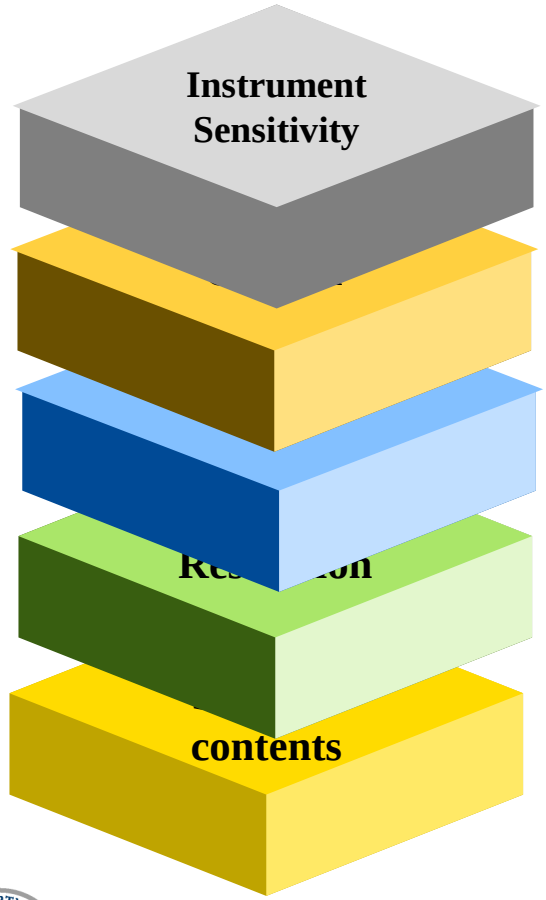
Path Forward …

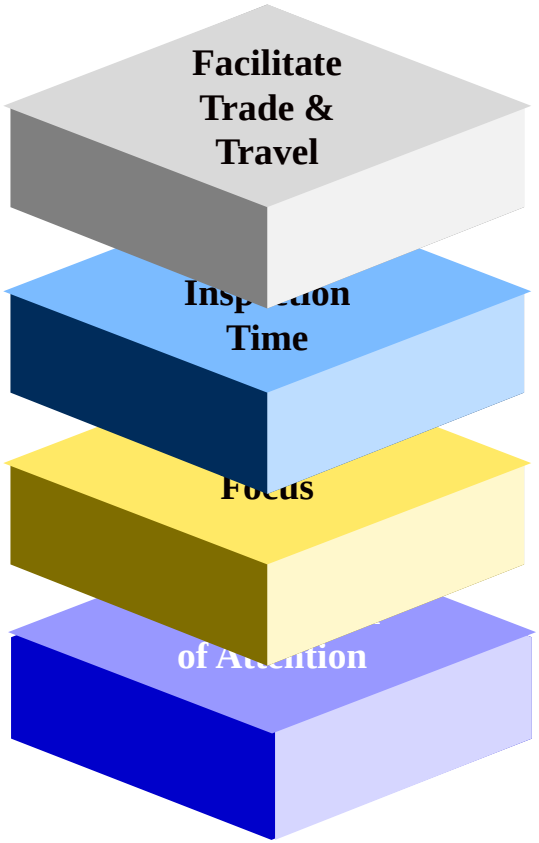
Constraints

Instrument

Human

Then What?



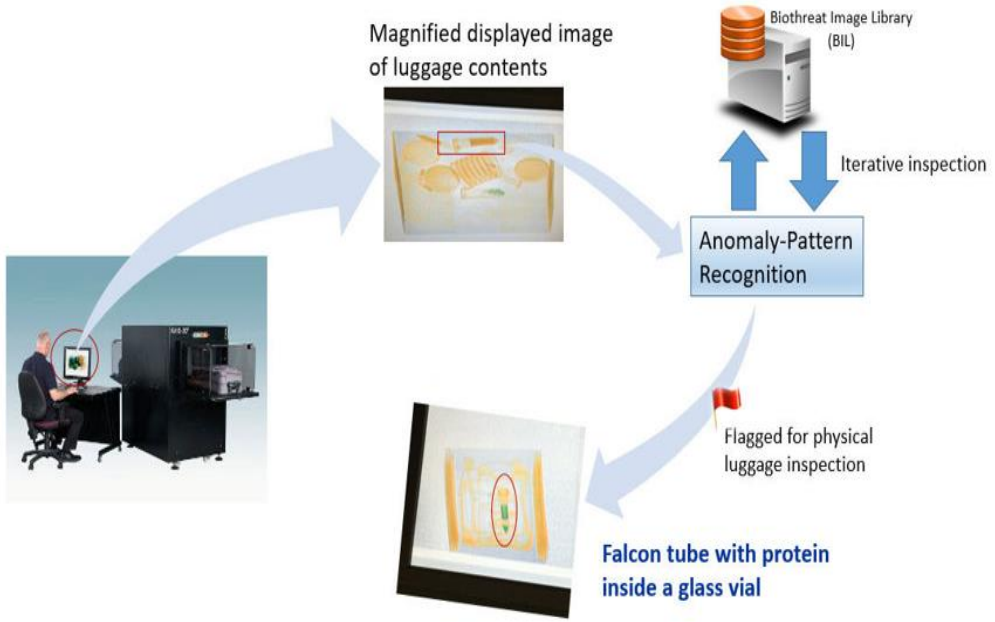


Anomaly – Pattern Recognition Algorithm (APRA) + Biothreat Image Library (BIL)

APRA- BIL Enhanced NII in Passenger Baggage – ConOps

APRA-BIL Requirements:

- **Multiplexing capability**
- **Algorithm***
- **BIL****



** proprietary to x-ray manufacturer*
*** unique to x-ray machine model*

Alternative Solution:

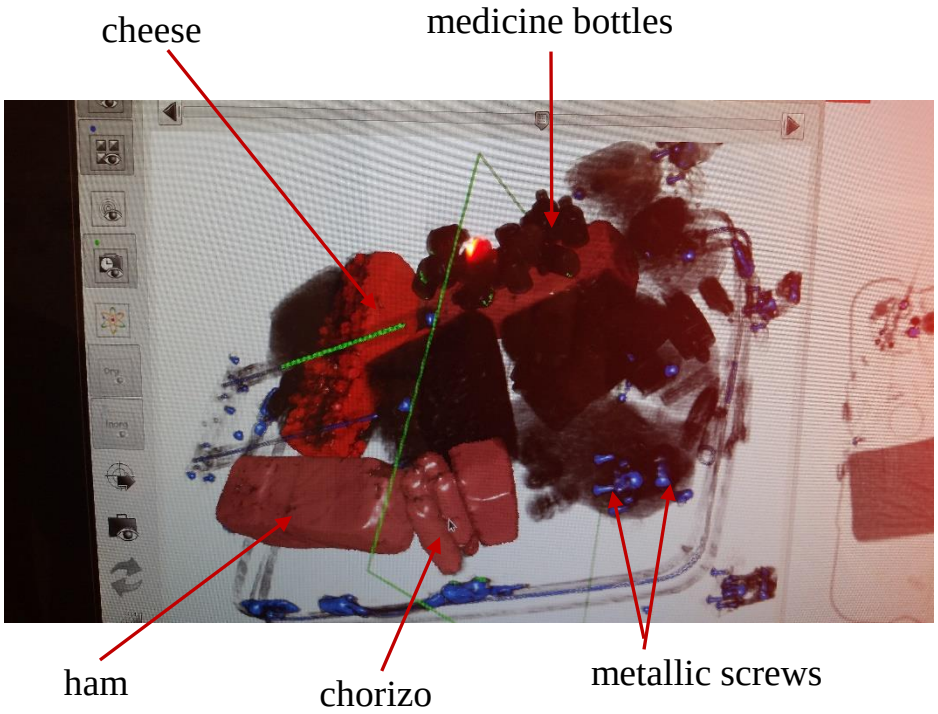
- **Computerized Tomography X-Ray Technology**

Benefits:

- Full volumetric spiral scanning and 3D imaging
- Multiplexing capability
- Stand alone or integrated with the baggage handling system
- Image archiving
- Barcode reader

Disadvantages:

- Slow
- High capital and operating costs



Summary of X-Ray Agriculture Requirements

- Organic and inorganic material enhancement
- Edge enhancement
- Density differentiation enhancement
- 1x to 8x zooming
- Shield alarms capability
- Anomaly-pattern recognition algorithm
- Image saving capability to continuously build the biothreat image library
- Multiplexing capability
- Image with metadata retrieval to a CBP-approved external HD
- Scan/image counter & reporting capability
- Allow future network connectivity
- Accommodate variable speed belts
- Emergency stop and continuous mode switches

U.S. Customs and Border Protection