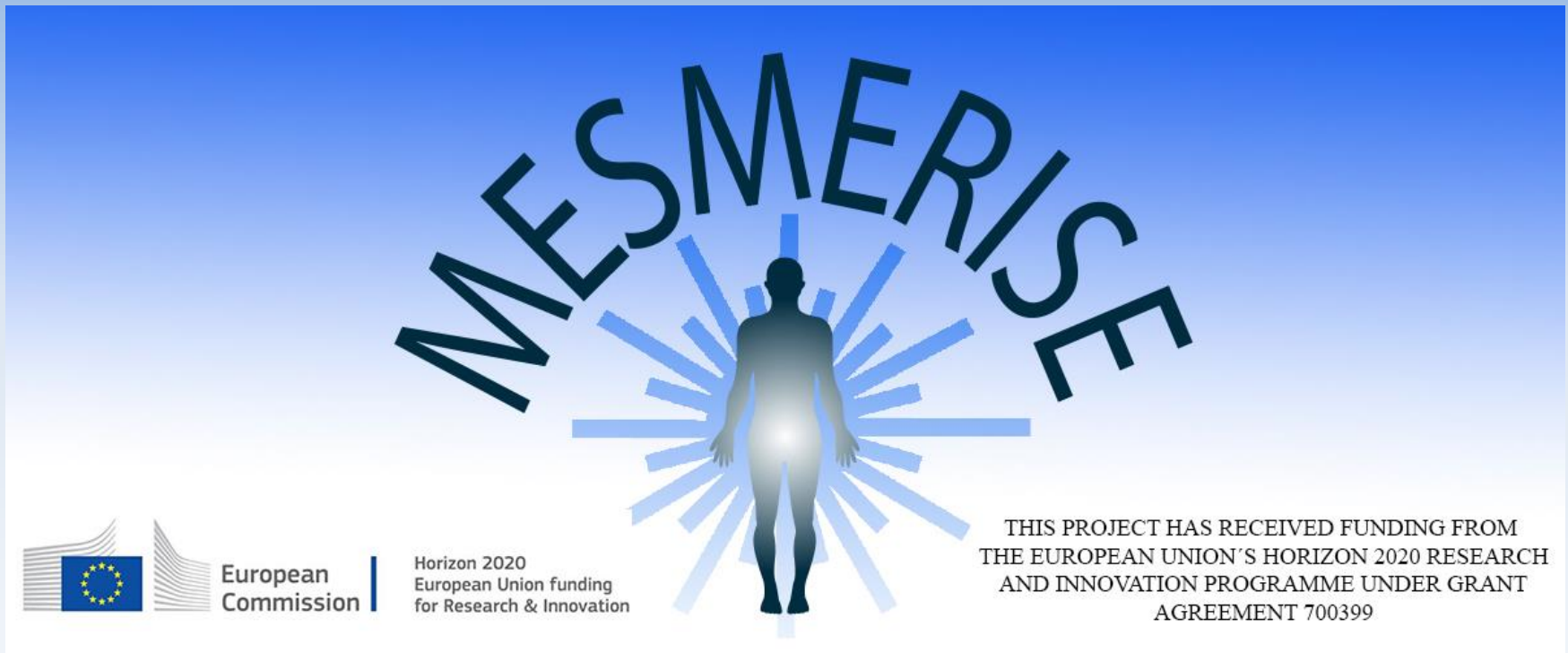




Multi-Energy High Resolution Modular Scan System for Internal and External Concealed Commodities



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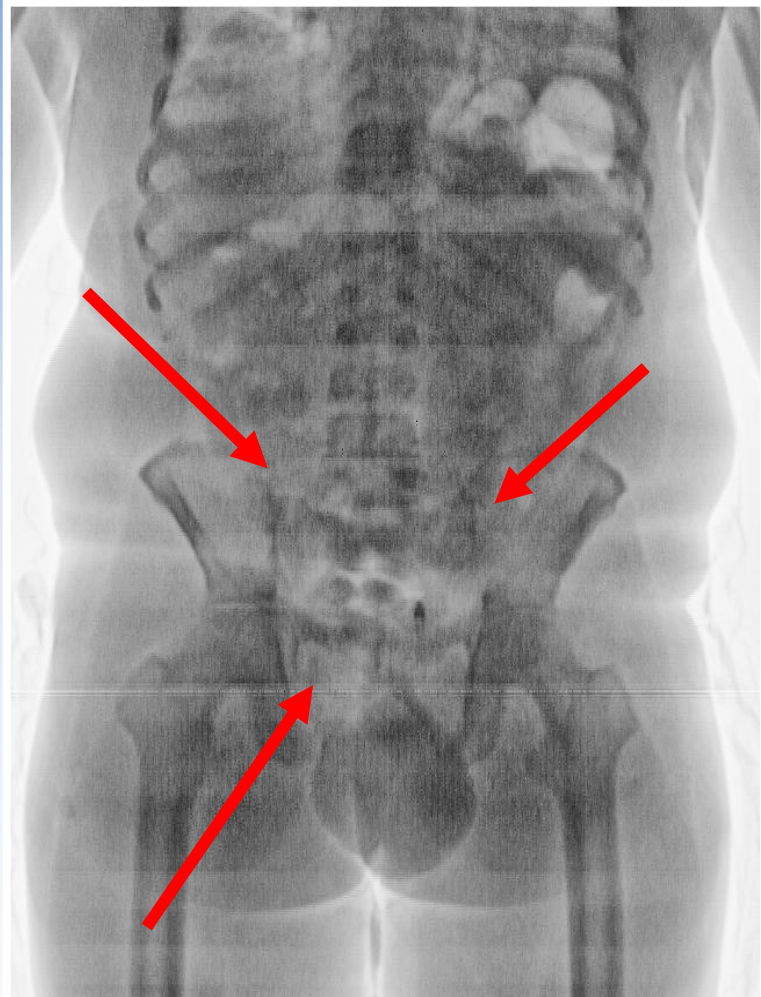
ADSA-CBP-01
Boston
June 21st 2018



So What? Who Cares?

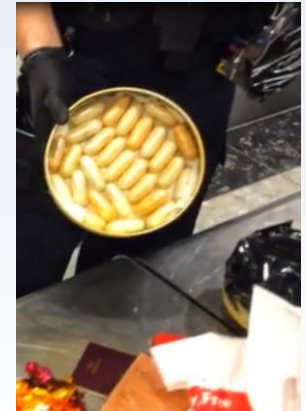
- Space: Drugs concealed inside people to circumvent a border control.
- Problem?
 - i) Image analysis relies on skill level of human operator
 - ii) Not enough information from x-ray
 - iii) Liquid drugs challenging to discern on low-dose transmission systems.
- Solution: Multi-energy x-ray to provide spectral information for automated detection process, AI to process images for additional detection algorithm.
- Results: Prototype being constructed with M/E array; detection software testing and optimisation underway. Planned to trial in UK Nov 2018
- TRL: 6 (target)
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Operator view on low-dose system

- In 2005 UK Customs introduced low-dose x-ray scanners to combat this growing trend of smuggling. Successful, but trend in liquid drugs brings greater challenges.
- In 2013 the European-led Customs Detection Technology Project Group was permitted by the European commission to select collective challenges to address.
- One was to automatically detect and identify drugs and explosives on, or inside a person. €4.9 million was considered sufficient. MESMERISE was the successful bid.



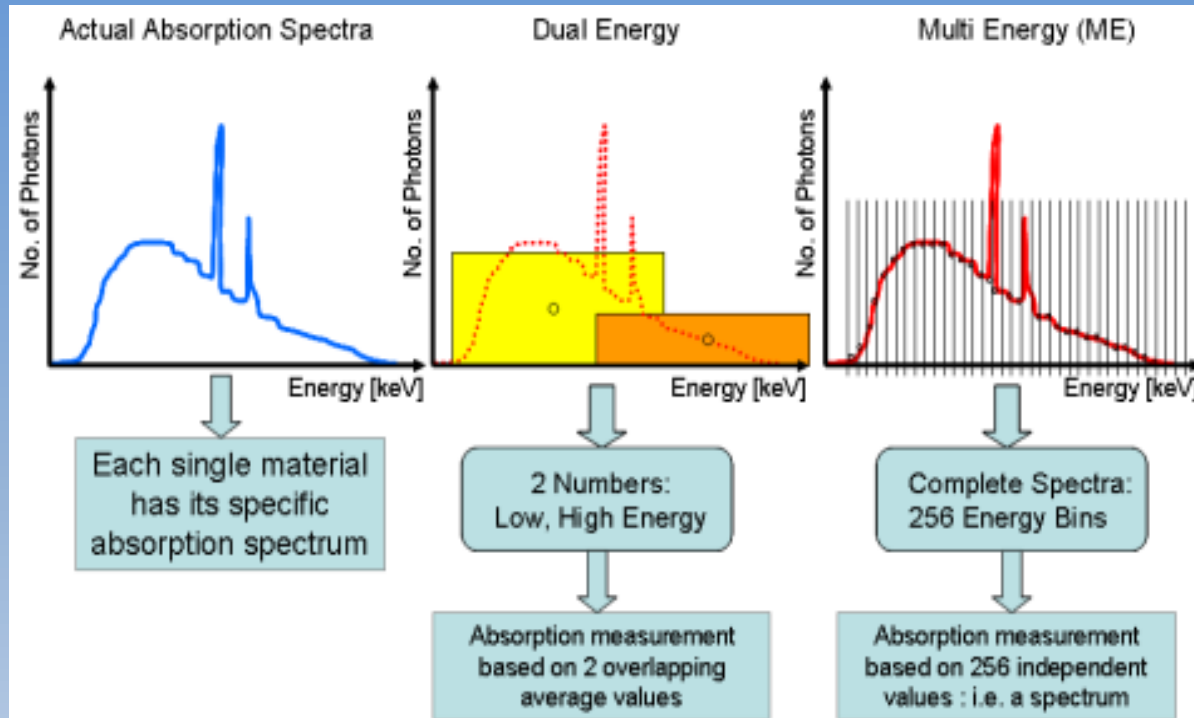
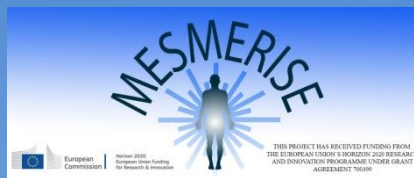
Recovered powder packages



- MESMERISE is developing two technologies.
 1. Multi-energy x-ray for internal concealments – TRL 6
 2. Infrasound for external concealments – TRL4
- This presentation will focus on the multi-energy device.
- Project includes end-users: Customs UK and Norway, Guardia Civil (Spain)

MESMERISE goals:

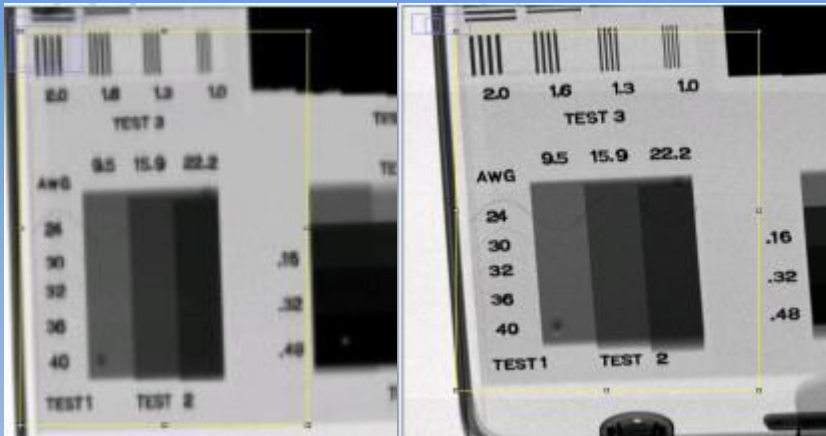
- To develop a high-resolution, non-intrusive **x-ray spectrometric** CdT/CZT scanner able to **automatically detect and identify** both internal and external concealed prohibited or restricted commodities.
- Commodities include Cocaine (liquid and solid), Heroin, MDMA, Currency, knives, explosives.
- If end-users comfortable with performance over current technology, then device will be dove-tailed into existing process in UK.



- New spectrometric detectors offer many advantages: each transmitted x-ray photon is individually detected and its energy measured by a semi-conductor crystal (CdTe/CZT).
- The **direct conversion in CdTe/CZT** and the electrical properties of this material ensure energy measurement promptly and with a good energy resolution

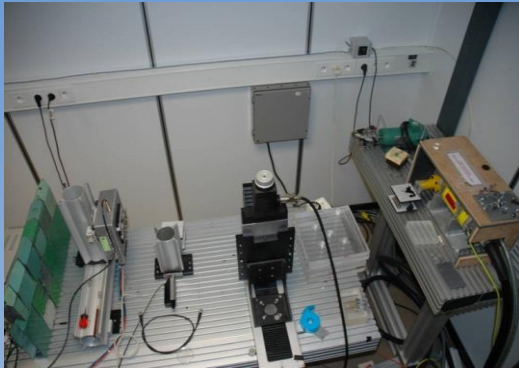


Improved Image Resolution



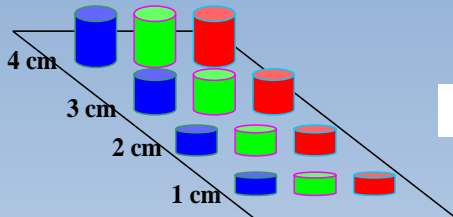
Test	Conventional	ME100
Wire visible in air (AWG)	32	40
Wire visible under 9.5mm Al (AWG)	24	32
Spatial Resolution (mm)	1.6x1.3	1x1
Penetration of steel (mm)	22-26	26-28

- Detailed view of an image from the ASTM F792 test piece acquired by a conventional detection system (left) and the multiple energy detector (right) with same acquisition parameters.
- Operators will benefit from improved image quality which helps them to maintain their skill and validate capability of automated detection software.



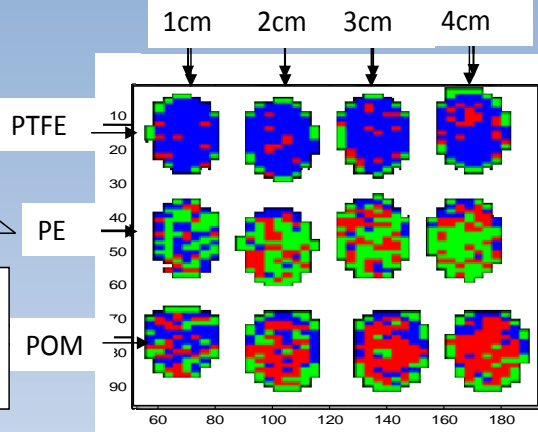
Information processing

- ME calibration, superposition
- Method using probability density
- Density & Zeff identification

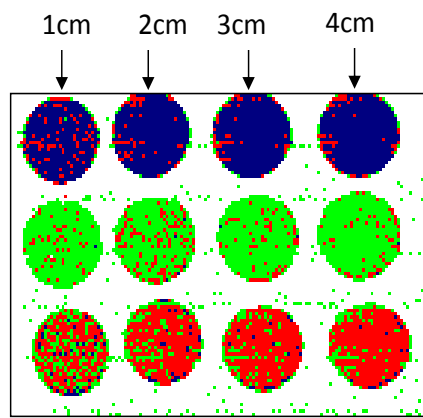


- blue : PTFE (teflon)
 - green: PE (polyéthylène)
 - red: POM (delrin)

Dual-energy detector (« sandwich »)



Spectrometric detector



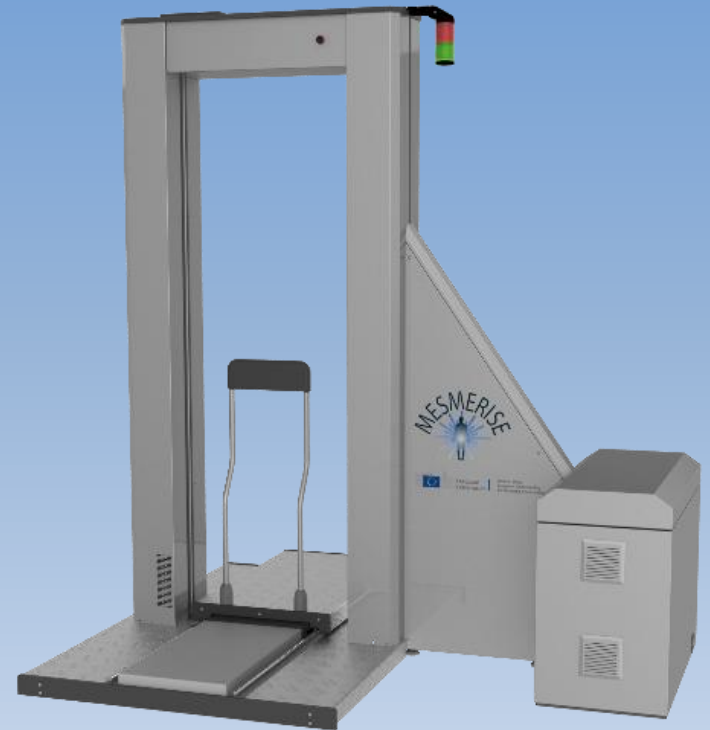
False detection rate decrease



X-MESMERISE:

A full body non-intrusive ultra-low dose x-ray scanner (FBS), usable upon consent by the final user, for internally (and externally) concealed commodities detection identifying the object and warning the operator:

- **Quick:** the whole operation could be deployed in a very convenient footprint, offering enhanced capability without the resource and security implications of removing a suspect off-site to a medical facility. Ability to verify negatives also reduces delay to passenger and allows staff to resume frontline duties.
- **Low dose:** The dose per scan will be under the limits according to the EU standard limits (1mSv per year)
- **Automated Target Recognition System:** Provides a consistent response based on spectral and algorithmic information.






**EU Horizon 2020
Work Programme**

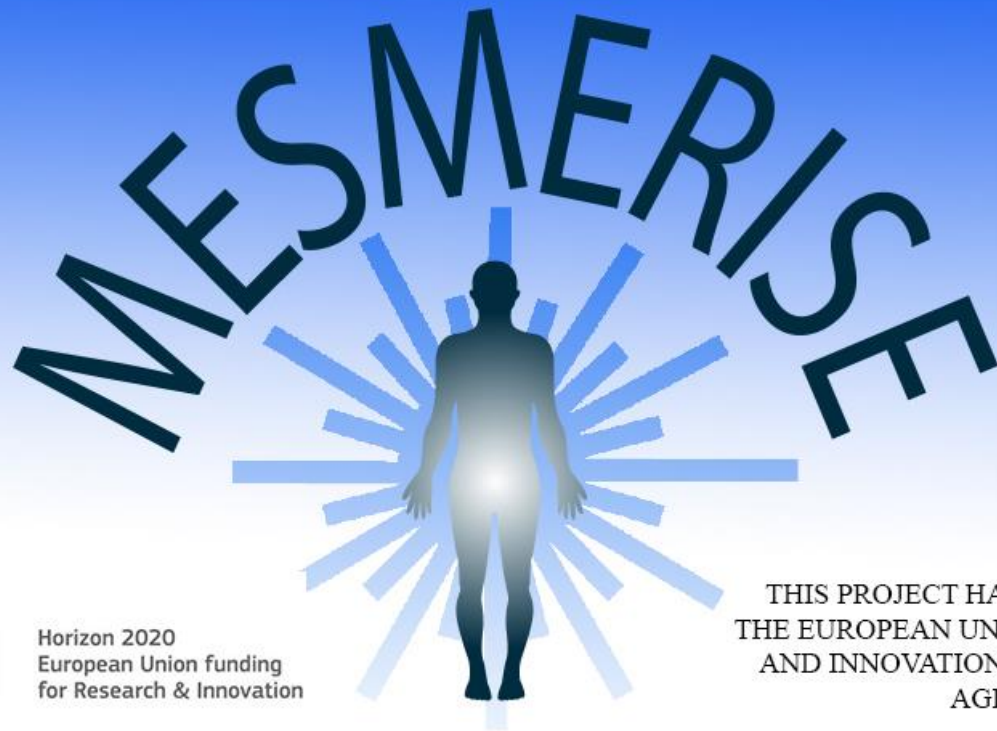
C-BORD - technologies for container scanning.
MESMERISE- technology to detect internal and external drugs.
PEN-CP - Network of customs practitioners.
2018 – Postal supply chain topic
2019 – Dense cargo screening topic



 (UK) Border Force + other EU Customs Administrations

- 16 Customs administrations co-operating to:
- Exchange information on technology and processes.
 - Share best practice.
 - Influence development of more bespoke technology for customs needs.

MESMERISE



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