Status Update
Weapons ATR For Checkpoint CT

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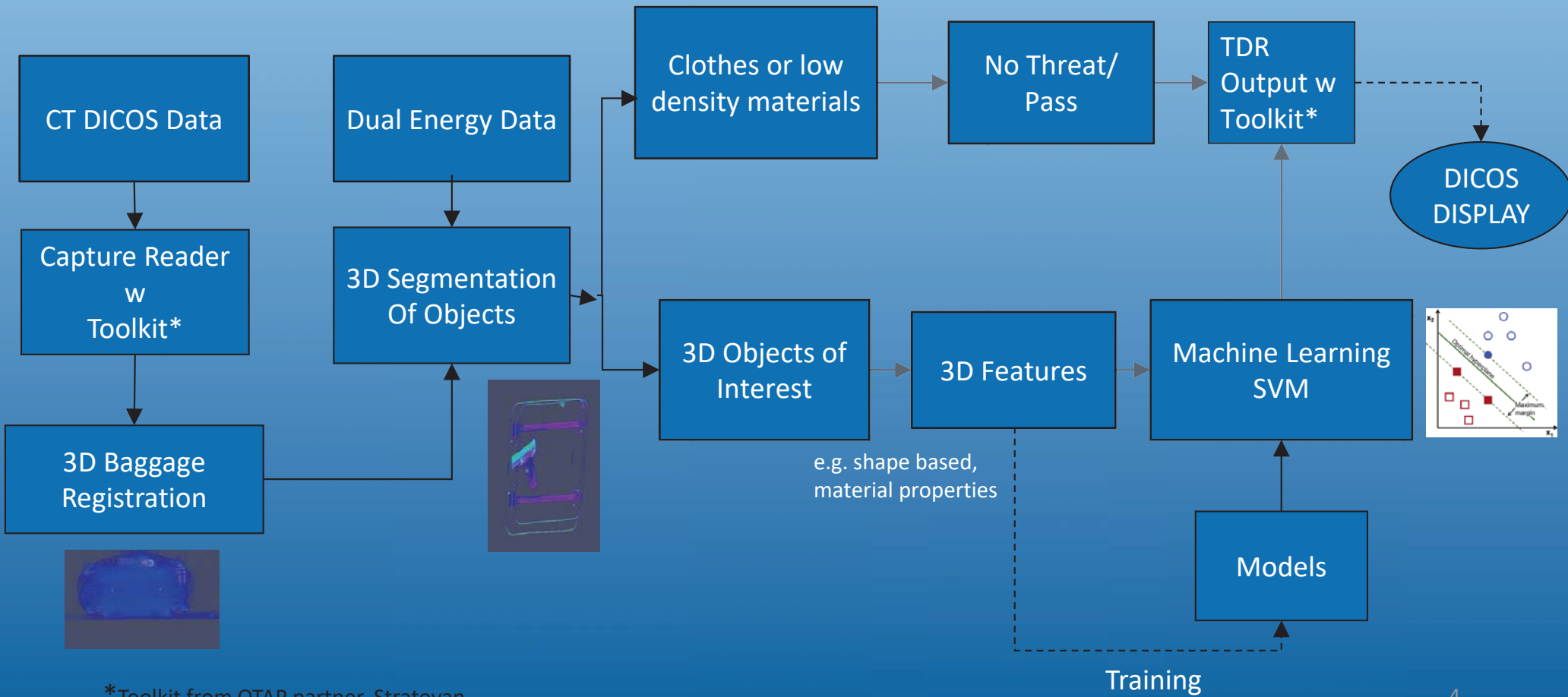
C A P T U R E

So What? Who Cares?

- Capture is developing 3rd party ATR for Prohibited Items (Checkpoint CT)
- Will reduce TSO workload dramatically (primary screen)
  - Our Goal – 75% of bags cleared automatically. 1 in 4 to secondary image review.
  - Huge opportunity for cost savings and security improvements.
- Utilizing OTAP Project Capabilities to develop ATR
  - Capture has expertise in 3D computer vision & machine learning to solve the problem

Project Area	Number of Projects
3D Image Reconstruction related projects	18
Computer Vision: Registration/Feature Extraction	42
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  - DICOS infrastructure enables 3rd party involvement….key issue, good progress!
  - Completed Task Order 1. Lots more work to be done.
- We are not presenting PD/PFA results today
  - 4 checkpoint CT images with weapons available to third parties
  - Access to data and funding has been challenging for third party ATR

OTAP Task Order 1 - Scope

- Current Task Order is for proving DICOS data flow from OEMs to 3rd Party Developers to Output
- We use Capture's existing ATR component technologies utilizing object feature extraction and machine learning
- Initial scope is Assembled Guns and Open Knives
  - Types of weapons to be determined at next data collection
  - Extend to other prohibited items in future
- 11 images so far (including 4 weapons)
  - More images will be acquired in May, July and August with OTAP
- We are delivering a pre-beta prototype ATR in May (completing task 1 goal)
- Next task order will provide additional funding for algorithm development
  - Would like to utilize Deep Learning approaches in the future
- Lots more work to do !!

ATR Flow Chart

CT DICOS Data → **Capture Reader w Toolkit*** → **3D Baggage Registration**

Dual Energy Data → **3D Segmentation Of Objects**

Clothes or low density materials → **No Threat/Pass** → **TDR Output w Toolkit*** ⇢ **DICOS DISPLAY**

3D Objects of Interest → **3D Features** → **Machine Learning SVM**

e.g. shape based, material properties

Models → Machine Learning SVM

Training

*Toolkit from OTAP partner, Stratovan

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Future :Deep Convolutional Neural Networks

- We think that deep learning convolutional neural networks can provide a broader, more generalized solution.
  - Needs more data but we have strategies to manage with less.
  - We can utilize SOC data.
- The CNN will extract its own feature maps and decide what is important.
  - Hundreds of hidden layers
  - GPU's are a big enabler to train these networks
- Feature extraction is a highly skilled and difficult problem and requires large investments to come up with the right features.
  - Checkpoint bag objects are unpredictable
  - Huge variation in objects (including threat and non threat)
  - More training data can capture object variation
- It is now possible to visualize and make sense of the data through the layers – not so much of a black box anymore.
- It is also possible to keep deep learning networks modular and add new capabilities without re-training already certified models.

Thoughts On Challenges Ahead ...

- Algorithm Approach Will be based on available Funding
  - Feature extraction – short term cheaper
    - Easier to demonstrate short term progress
    - Leverage existing algorithms, Add new ones
  - Deep Learning – long term cheaper
    - Higher upfront costs for architecture, data collection, labeling and computing resources
    - Can be modular and scalable
- Data collection – Feature Extraction + Machine Learning
- Data collection – Deep Learning
  - We have strategies of how to address large data requirements with less data – both in labeling as well as well as variation.
  - Data acquired could be shared with other third parties.

- Which Guns and Knives to include
  - Limit scope in Data collection 1 to reduce cost and demonstrate progress
  - Focus on assembled guns and knives for now that are size appropriate for checkpoint bags
  - Will depend on what is available on site and/or local borrowed/rented sources

- PD/PFA
  - Archive data from operational trials at real airports
  - This SOC data can be used to improve algorithm

Capture

- Capture is a 3rd party ATR Developer. We work with OEM's to provide solutions.
- Our Expertise is in 3D/2D algorithms for Computer Vision and Machine Learning.

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- We have experience in diverse industries from Security, Manufacturing to Medical.
- Capture is working on a Weapons ATR through Sandia National Laboratories (OTAP Project).