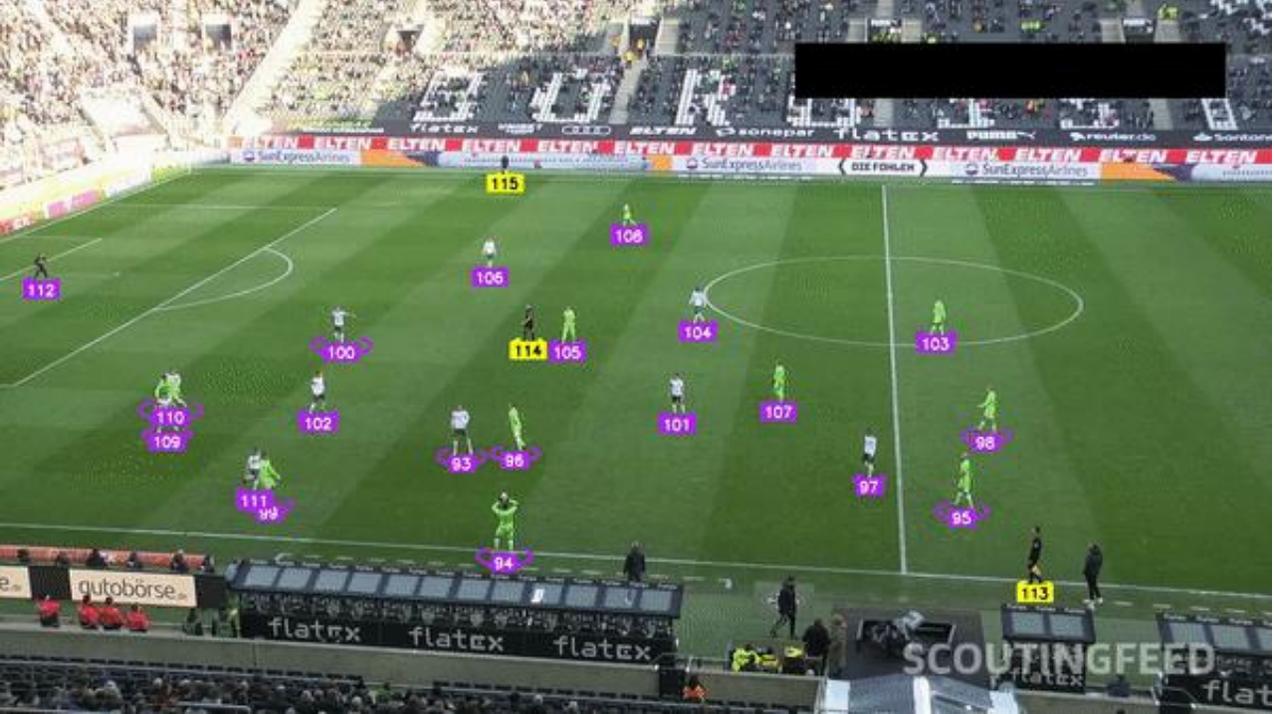
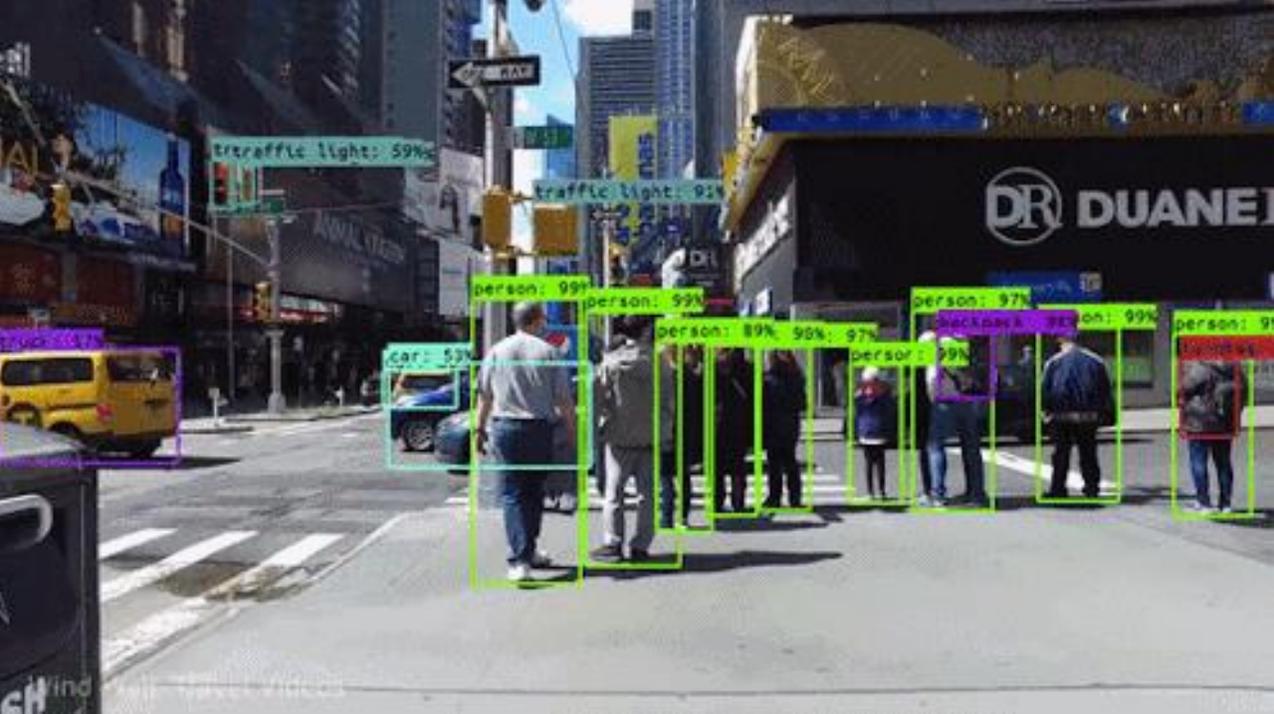
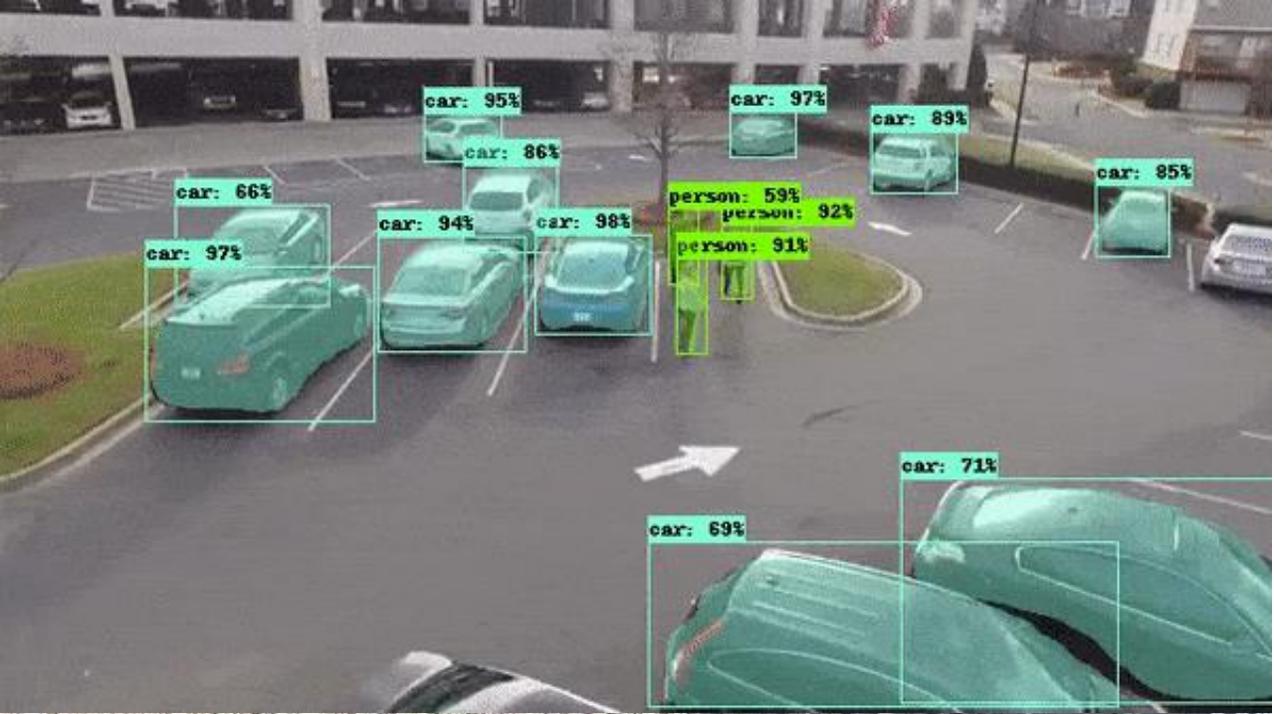
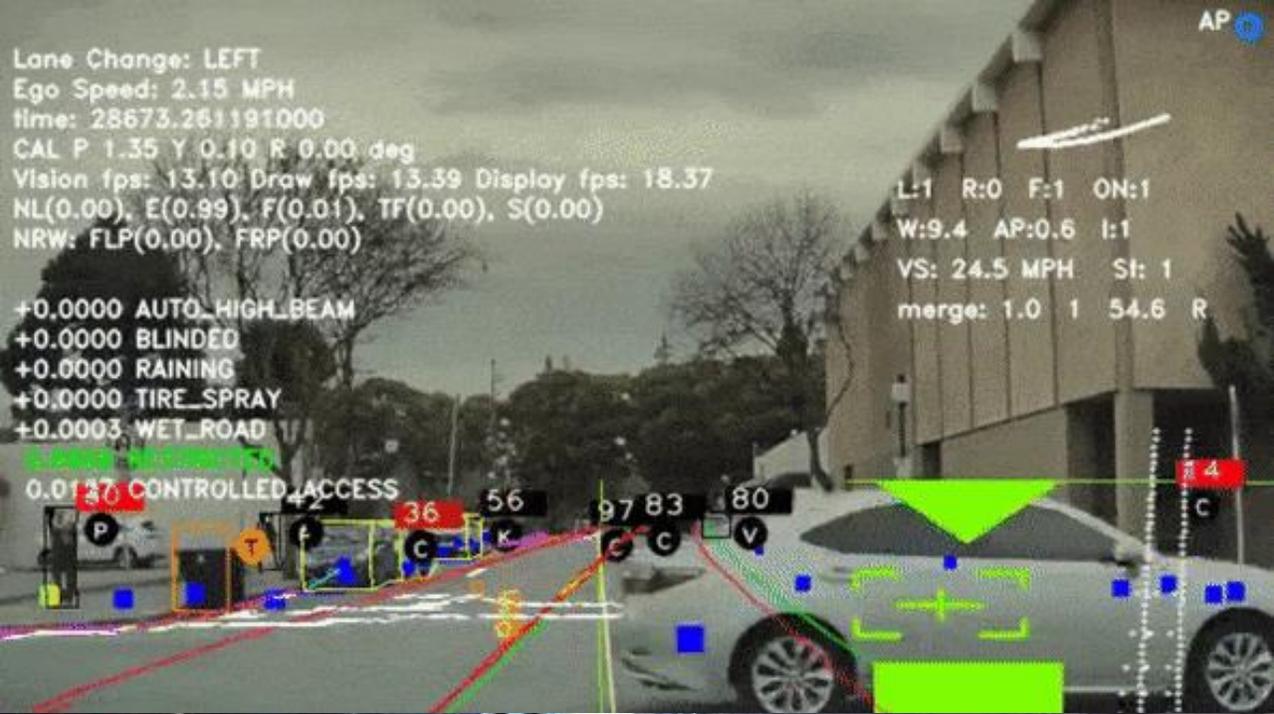


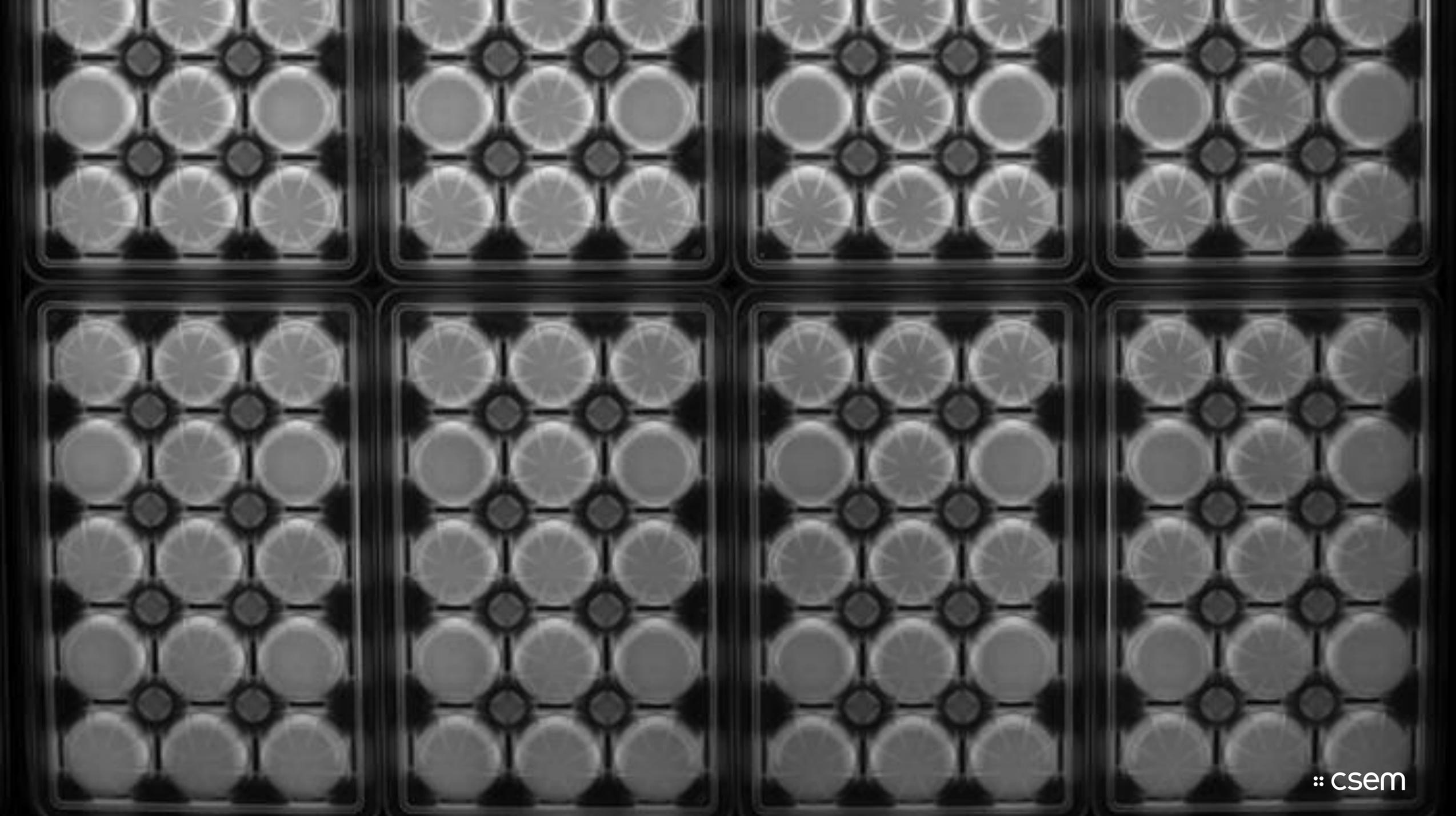


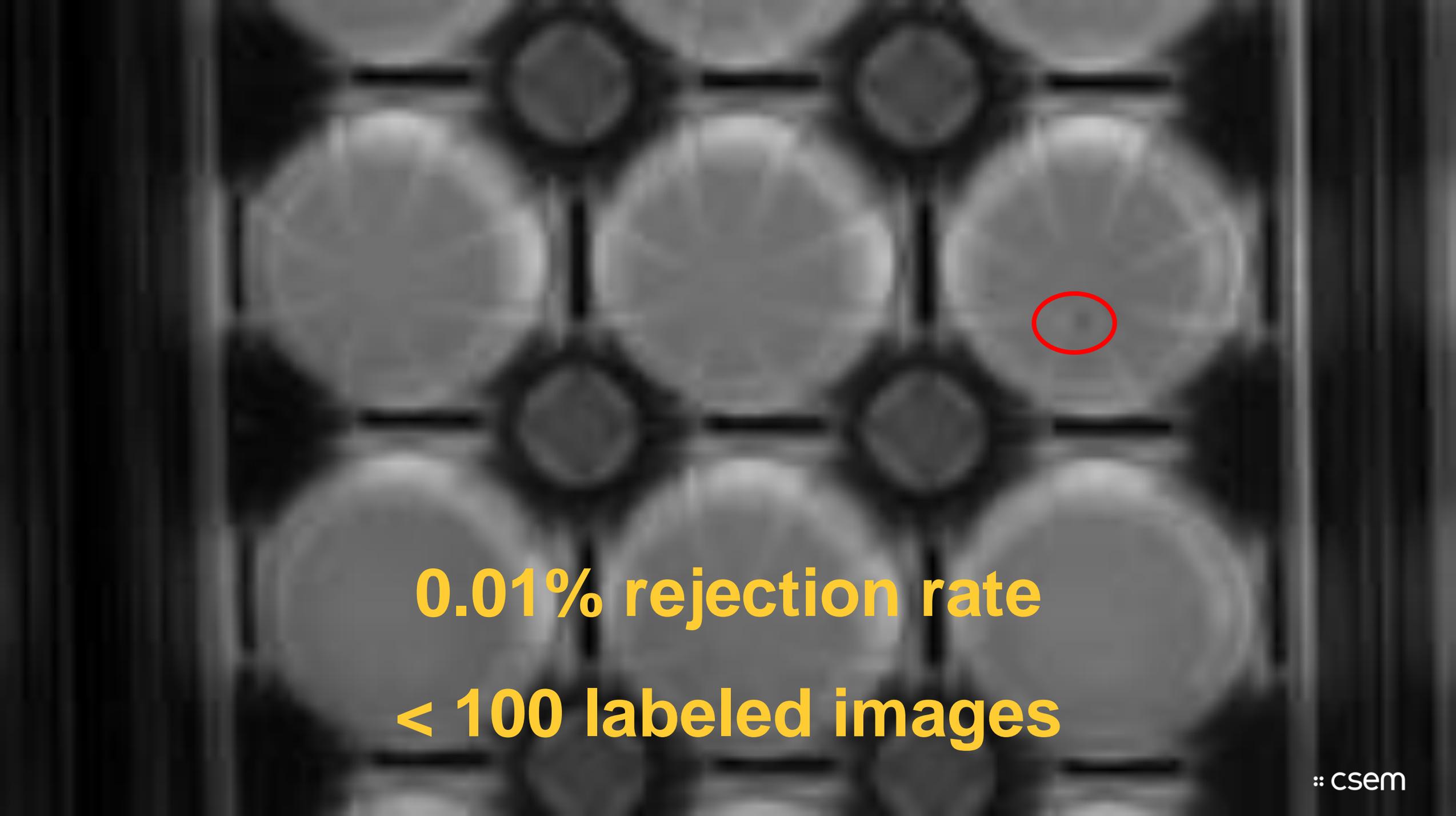
Dr. Francesco Crivelli  
Head of Research & Business Development

Chur, 09.09.2024

# AUGMENTATION AND SYNTHETIC DATA FOR INDUSTRIAL MACHINE VISION

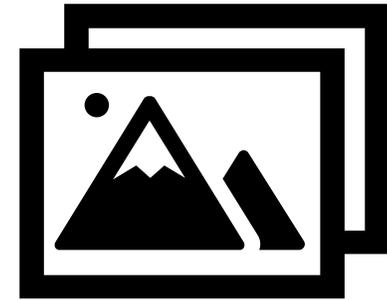
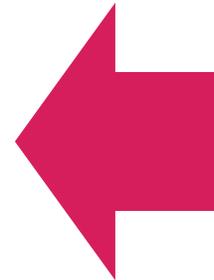
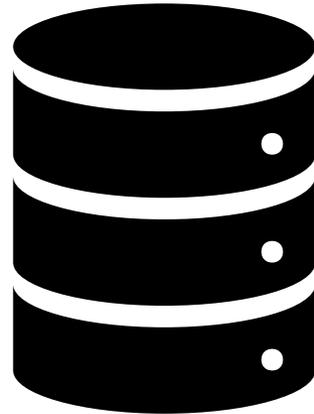
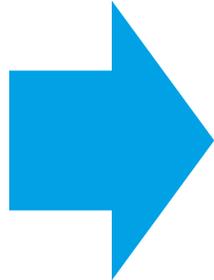
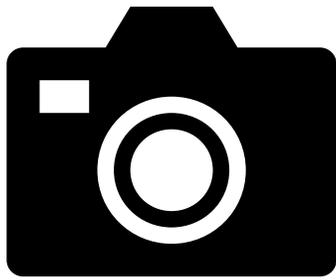






**0.01% rejection rate**  
**< 100 labeled images**

# HOW TO TRAIN DATA HUNGRY DL MODELS?



## Real images

- Little volume (100s-1000s)
- Expensive expert annotation

## Synthetic dataset of rendered images

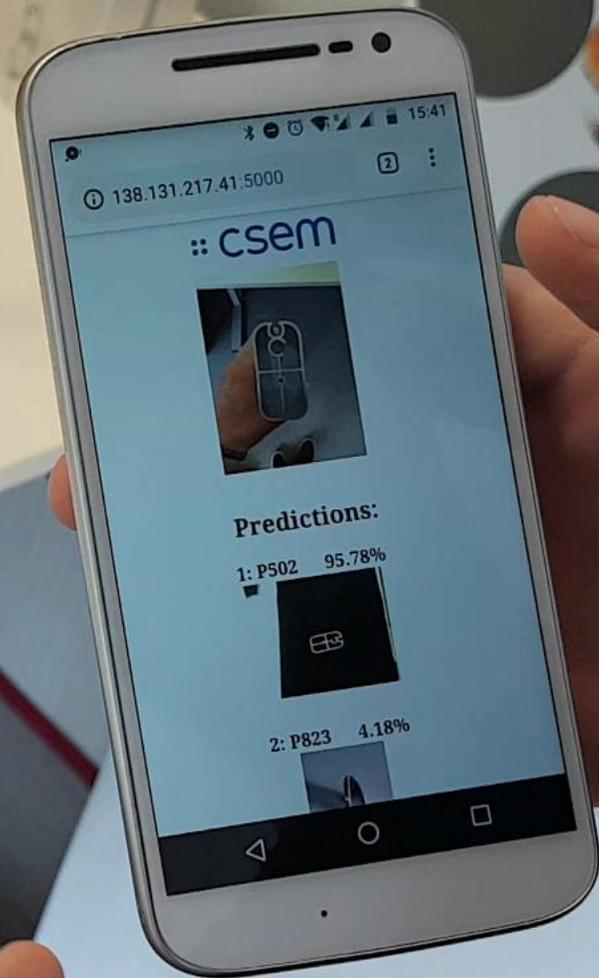
- Millions of images
- Automatically annotated

# AI COMPANION FOR ALUMINUM PROFILE RECOGNITION



# AI COMPANION FOR ALUMINUM PROFILE RECOGNITION



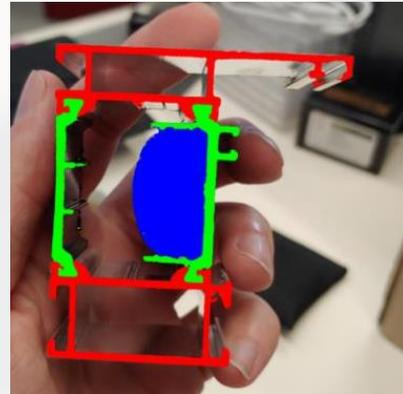
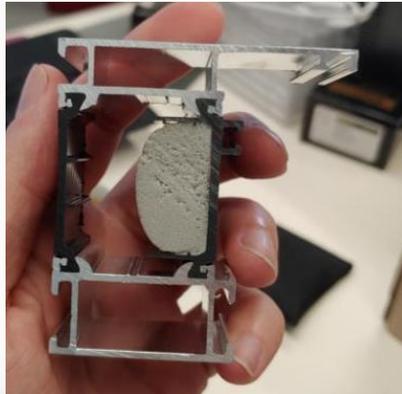


**New profile**



**Profiles database  
(>7'000)**

**Fingerprinting model**



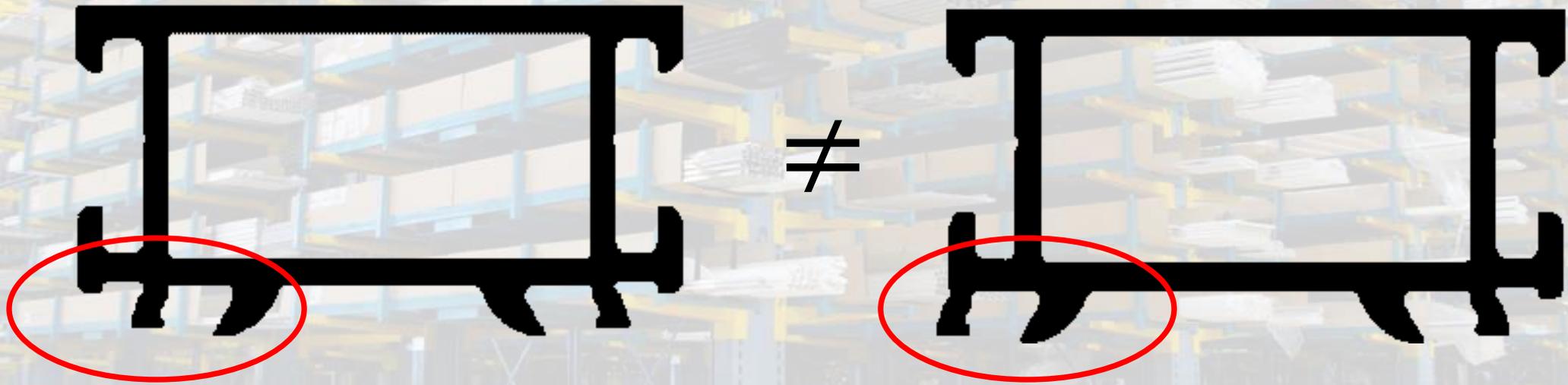
**Compare**



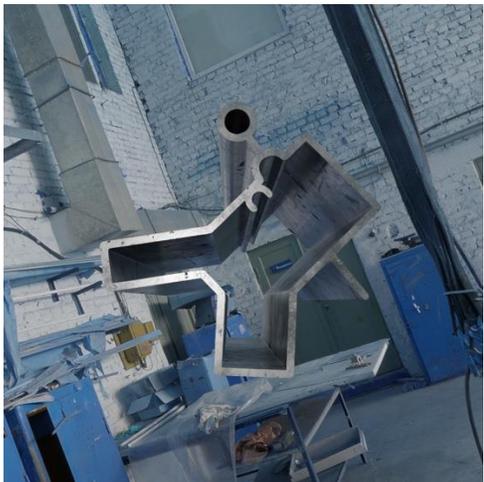
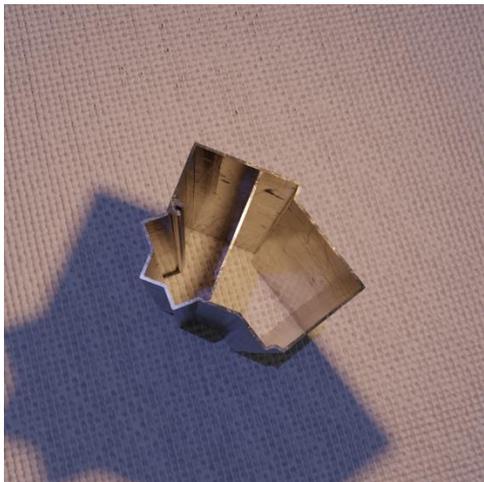
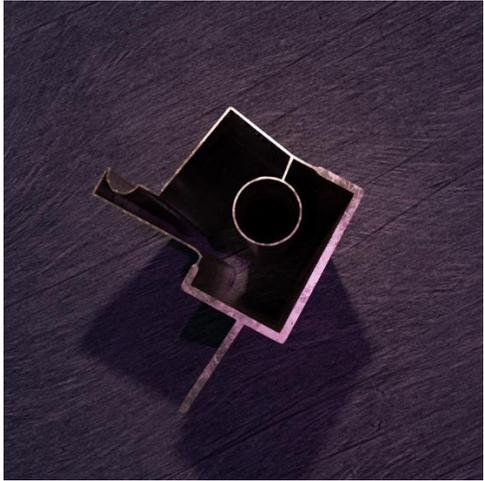
**Predictions:**  
1: 395720 0.23

**Segmentation model**

**VERY LARGE VARIATIONS  
VERY LITTLE DIFFERENCES**



# TRAINING BASED ON SYNTHETIC GENERATION



REAL

FAKE

Top 3  
99.9%

# deepProfile

einfach und schnell Profile erkennen

## DIE APPLIKATION

### PROFILIDENTIFIKATION MIT EINEM BILD

Bis 5 **Übereinstimmungsergebnisse** in **weniger als 3 Sekunden**, egal ob aus Aluminium, Stahl, Kunststoff oder Gummi.

deepProfile ist die **Lösung** zur Profilidentifikation in Herstellungsbetrieben, Produktionen, Beschichtungsbereichen, Baustellen oder in der fertigen Konstruktion, die meist nicht **schnell und zuverlässig** identifiziert werden können.

[MEHR ERFAHREN](#)



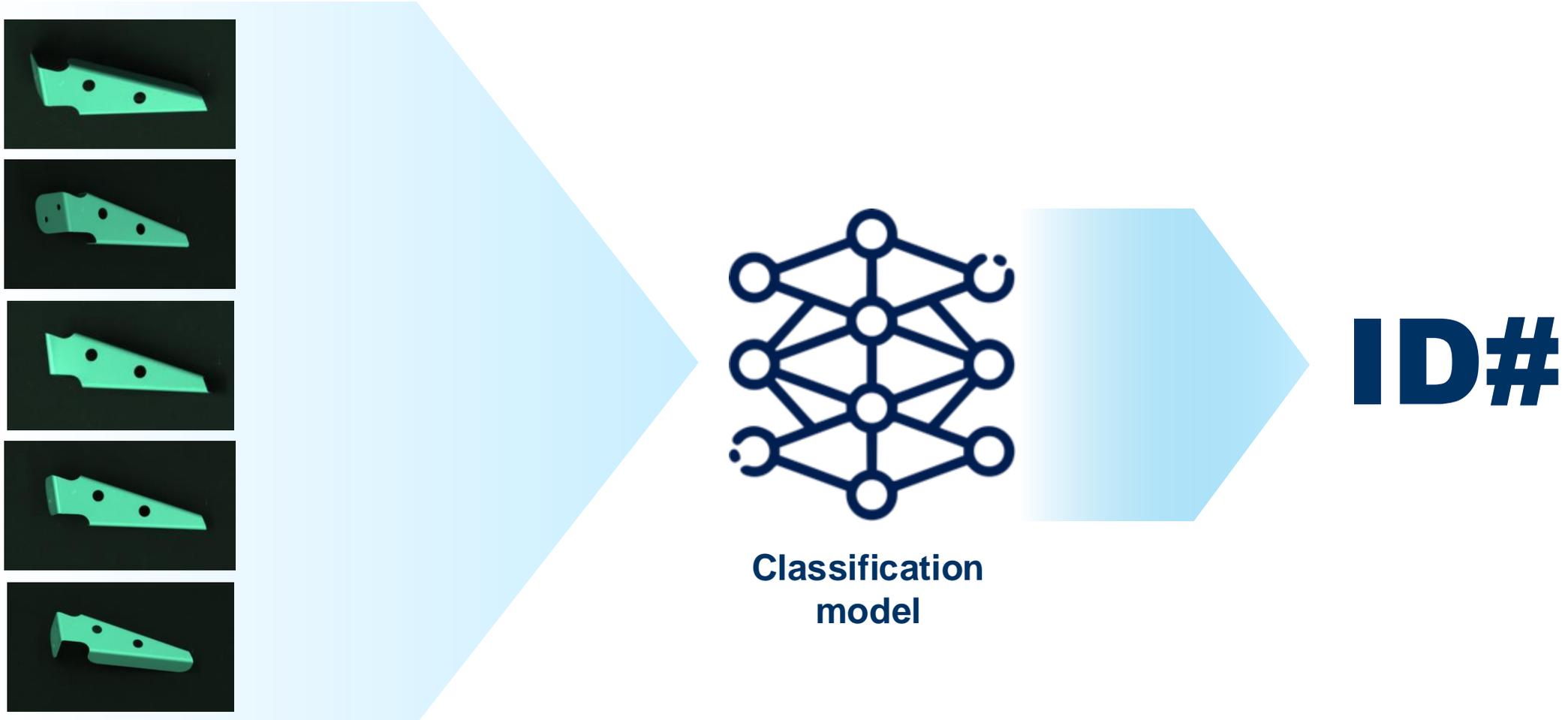
**PILATUS**



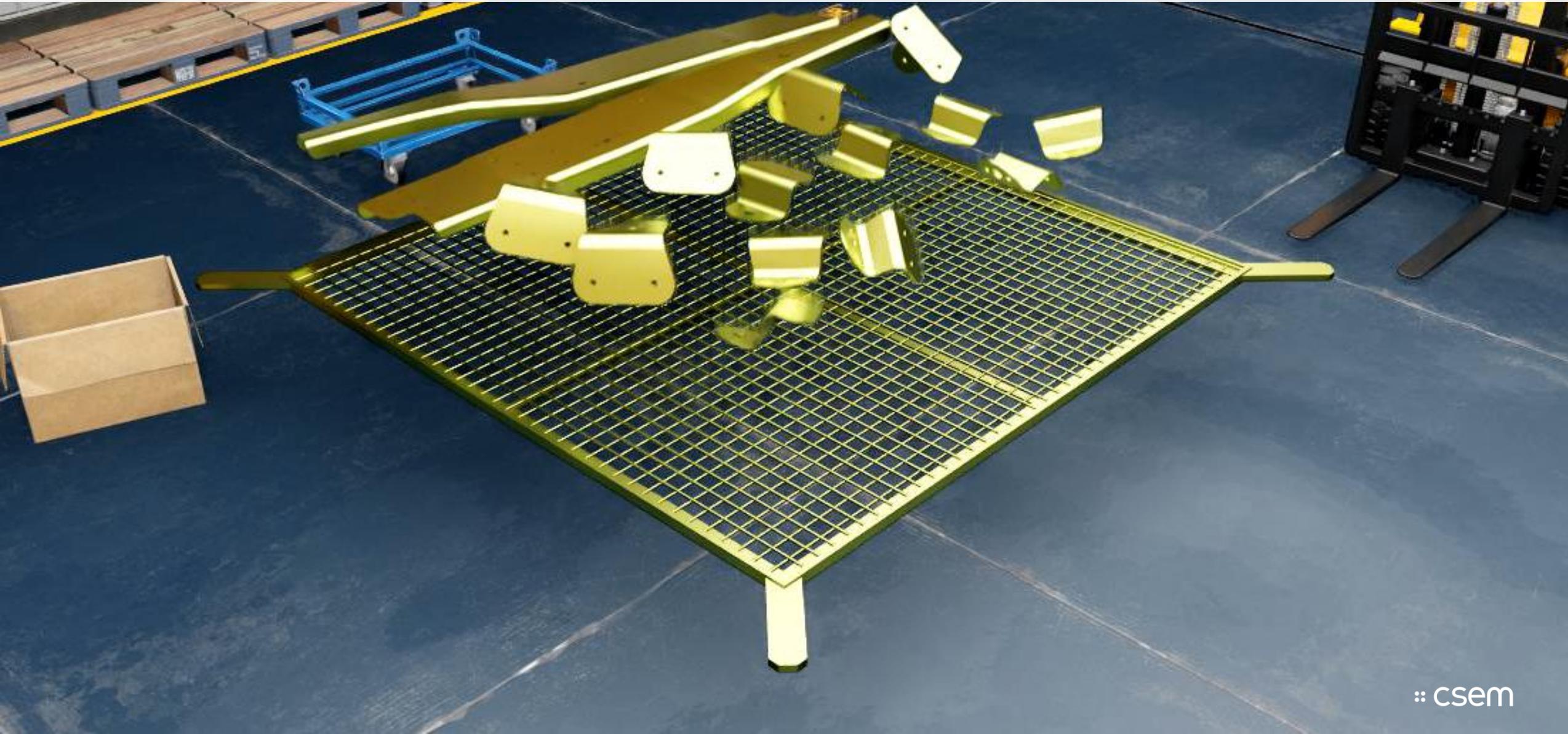
# ROBUST PART IDENTIFICATION

- 15'000 different parts
- Many very similar geometry
- Complex 3D parts in any orientation
- Fast & reliable

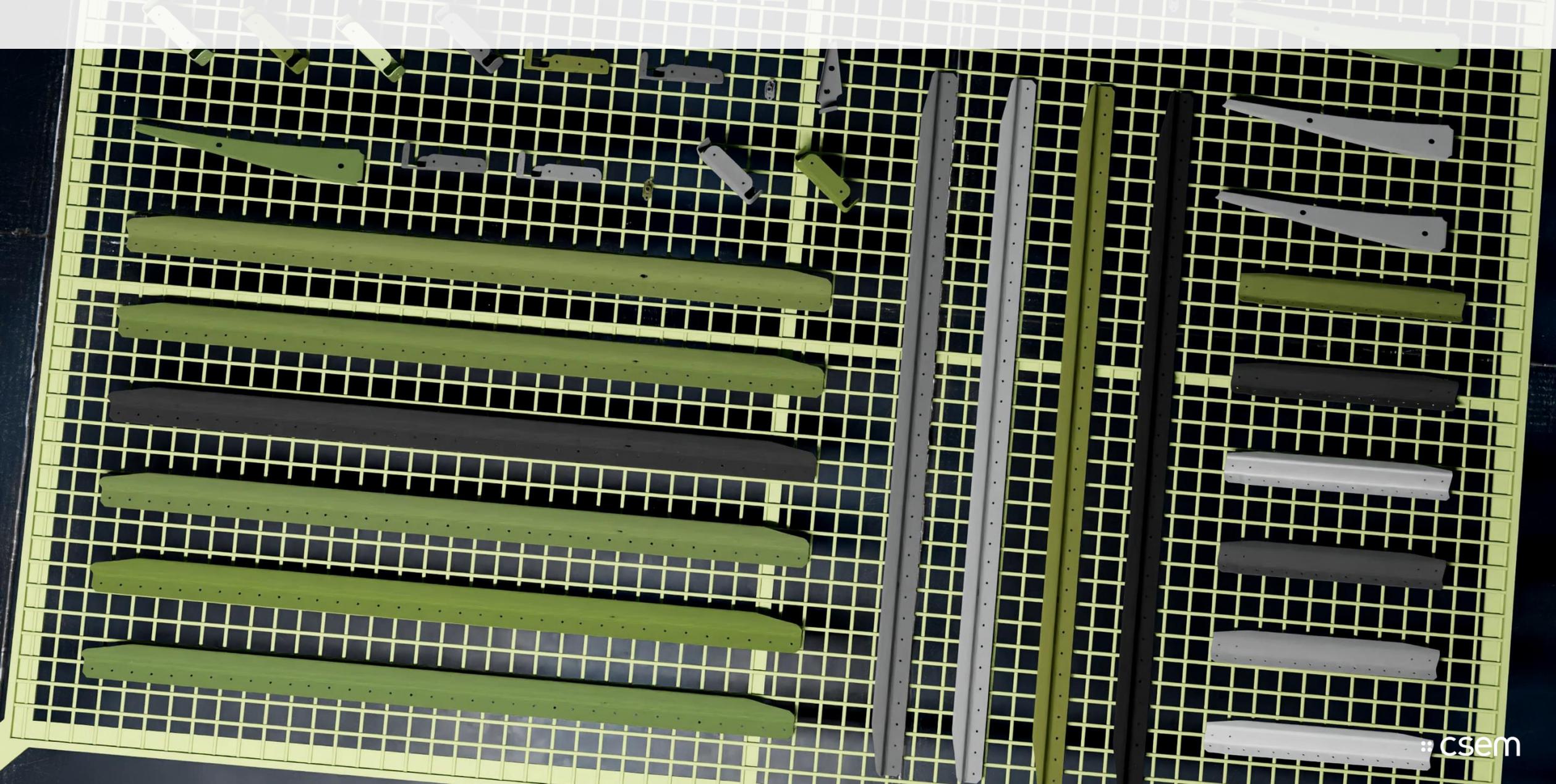
# PART RECOGNITION BASED ON 5 CAMERA VIEWS



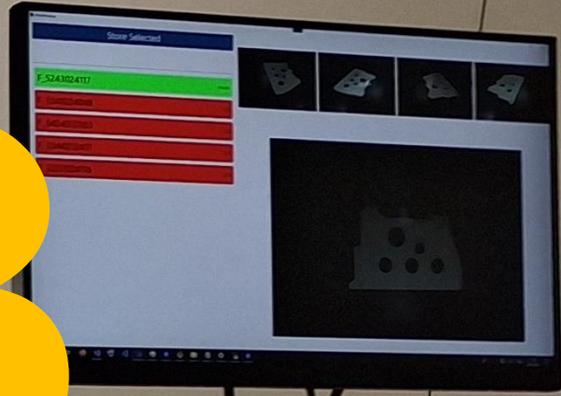
# TRAINED WITH SYNTHETIC DATA



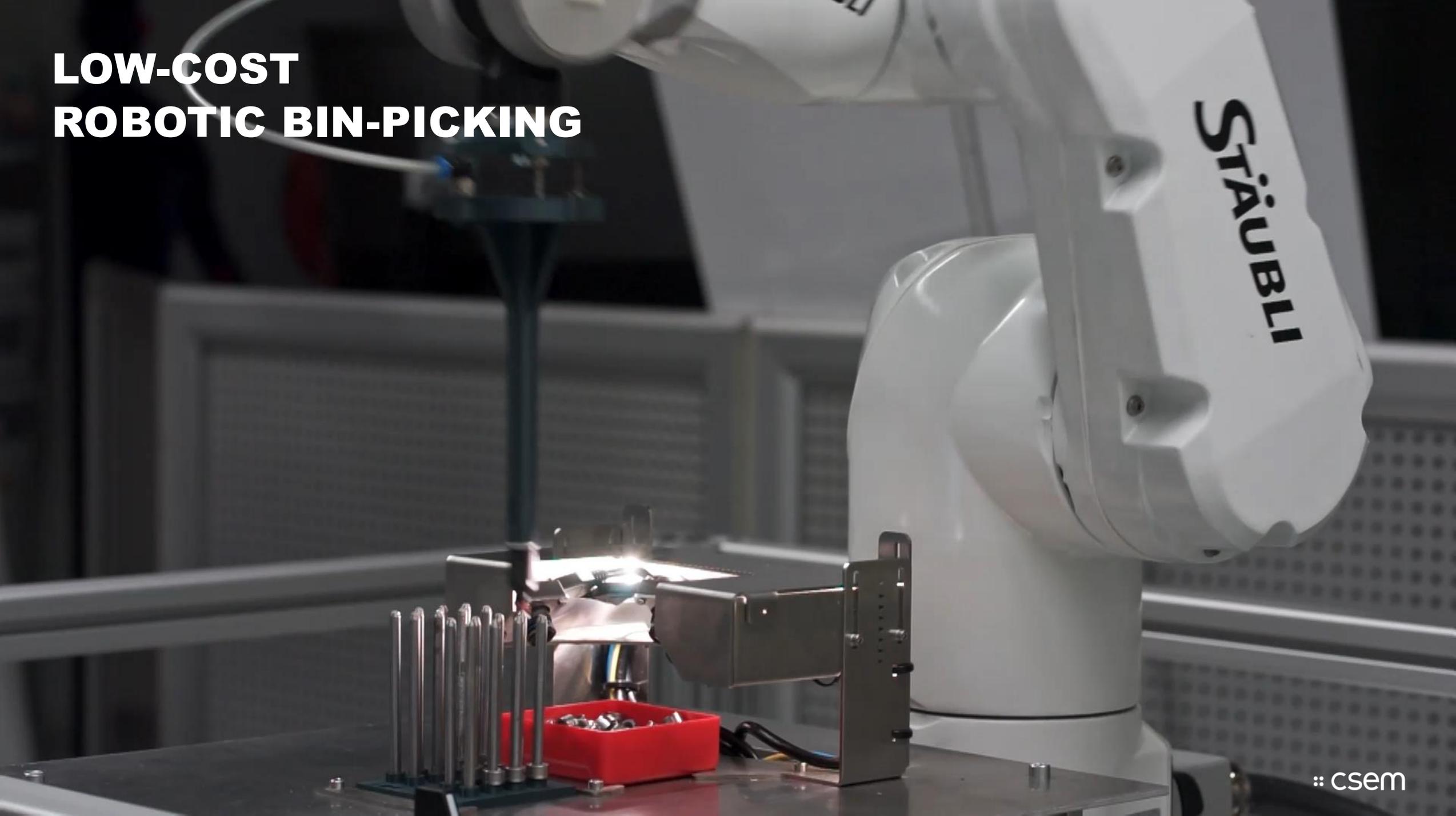
# RANDOMIZED CONDITIONS



**Top 3**  
**~ 100%**



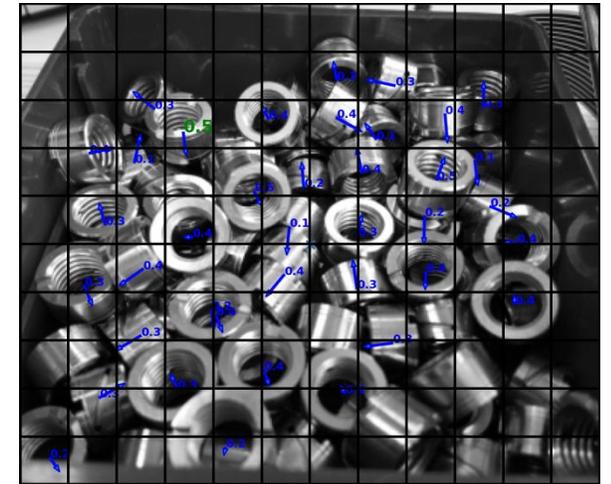
# LOW-COST ROBOTIC BIN-PICKING



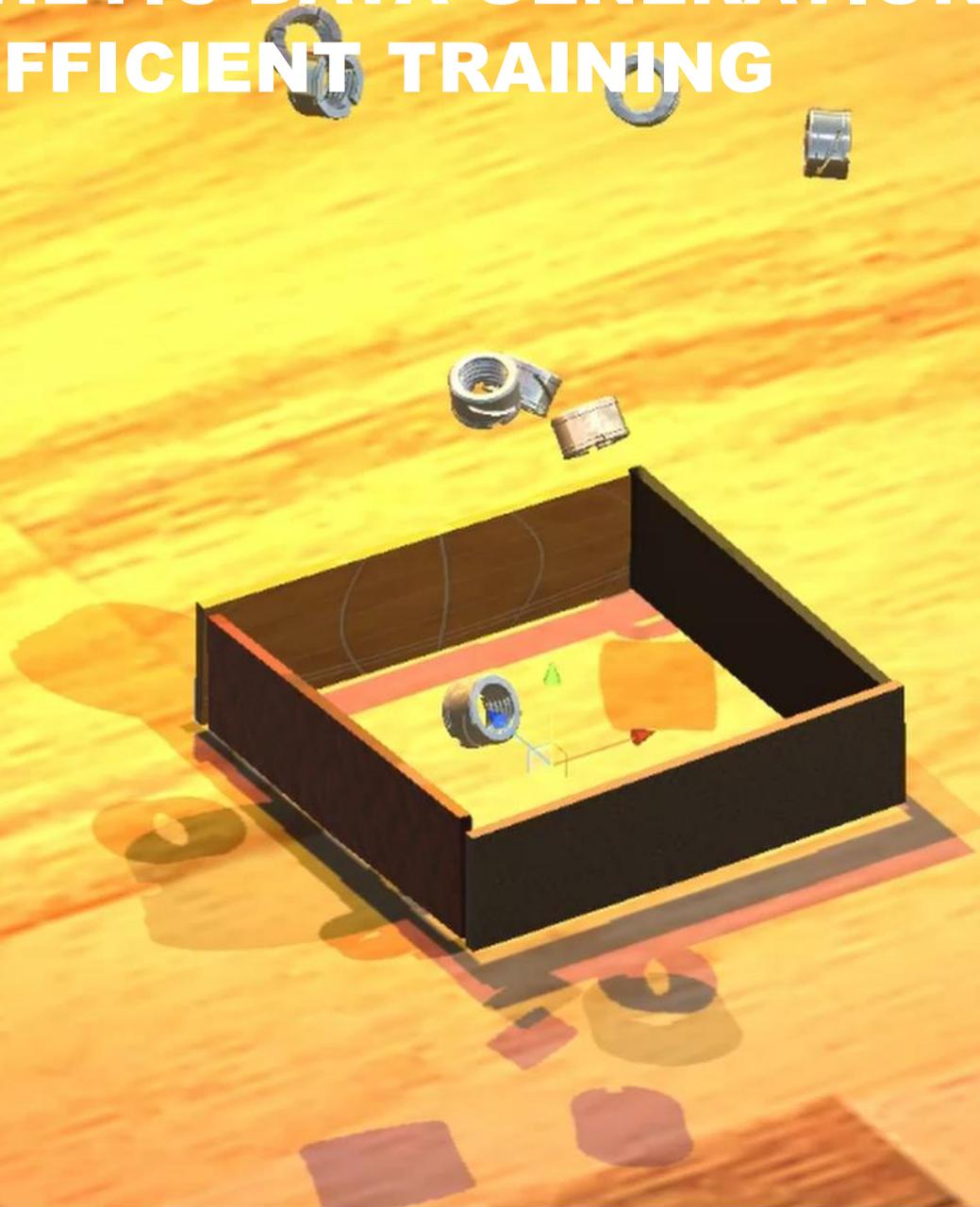
# OBJECT SEGMENTATION AND POSE ESTIMATION



Object segmentation  
and pose estimation



# SYNTHETIC DATA GENERATION FOR EFFICIENT TRAINING

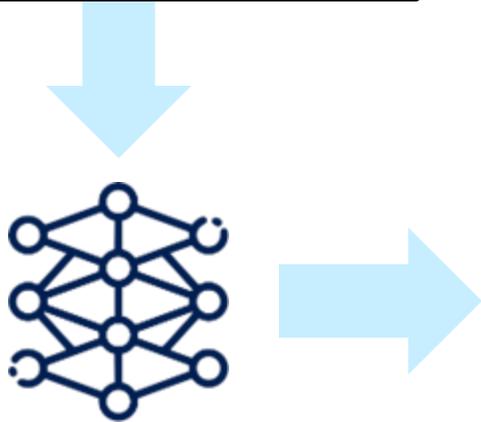


# ...WHAT ABOUT NATURALLY DISTINCT OBJECTS?

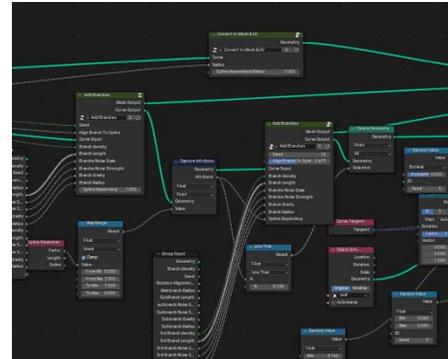


# GENERATING A 3D MODEL

From real 2D images  
(Gaussian splatting)



Physic based rendered textures  
(Procedural generation)





**RENDERED**



**REAL**

# NEOPHYTES DETECTION

 SBB CFF FFS

 csem

 zhaw

 ExoLabs

 Universität  
Zürich <sup>UZH</sup>

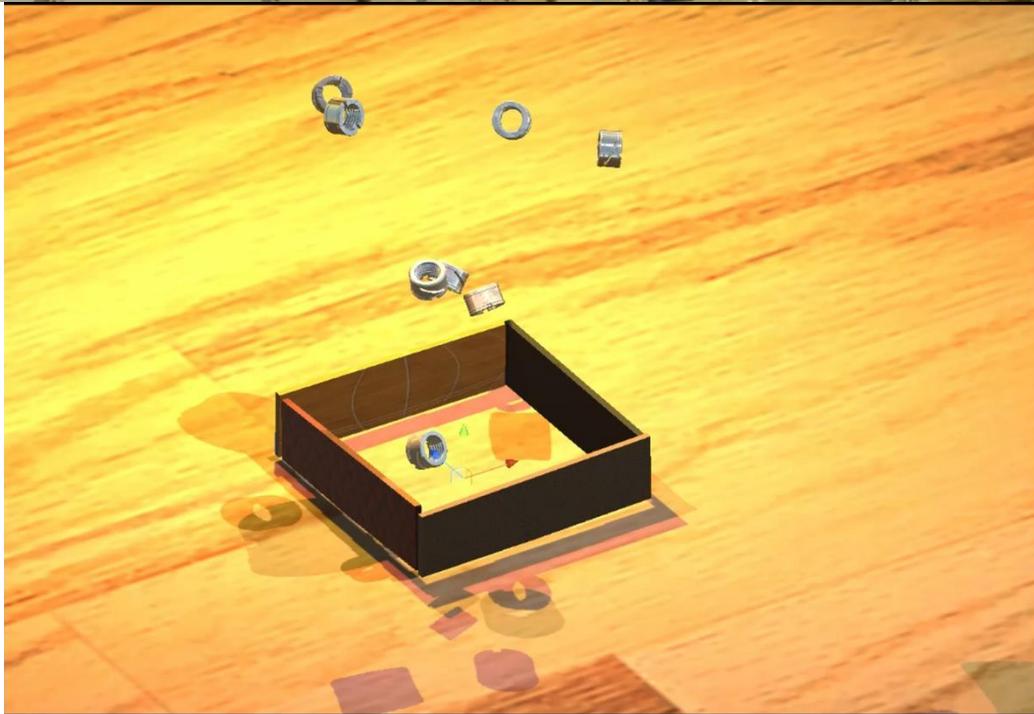
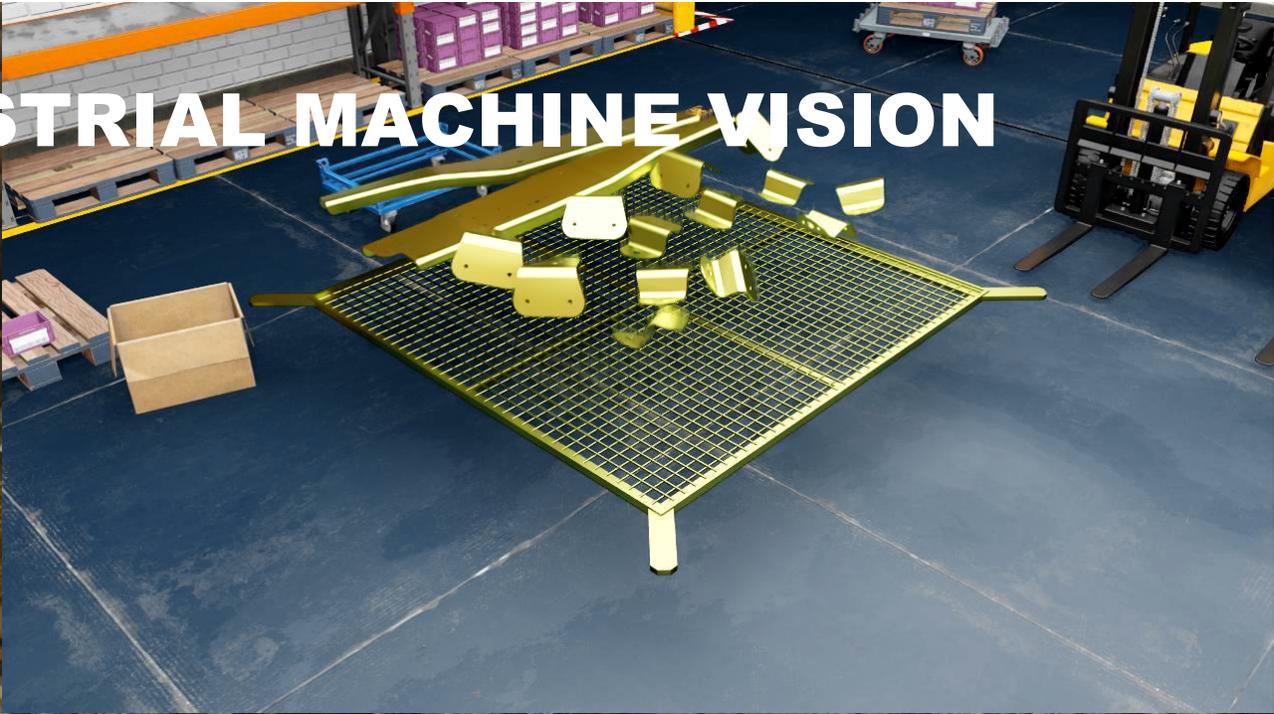


RENDERED



REAL

# SYNTHETIC DATA FOR INDUSTRIAL MACHINE VISION







**Dr. Francesco Crivelli**

**Head of Research and Business Development  
Industry 4.0 & Machine Learning**

**[francesco.crivelli@csem.ch](mailto:francesco.crivelli@csem.ch)**

**[www.linkedin.com/in/francesco-crivelli-csem](https://www.linkedin.com/in/francesco-crivelli-csem)**