

Deep Learning from Shallow Dives: Sonar Image Generation and Training for Underwater Object Detection

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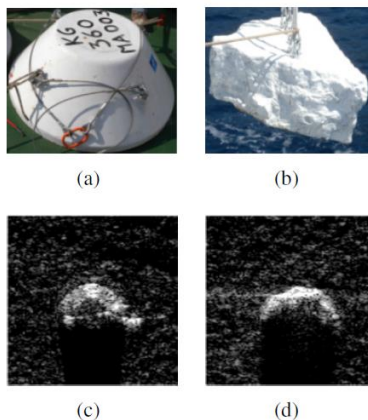
Object Detection in Sonar Image

► Object detection researches

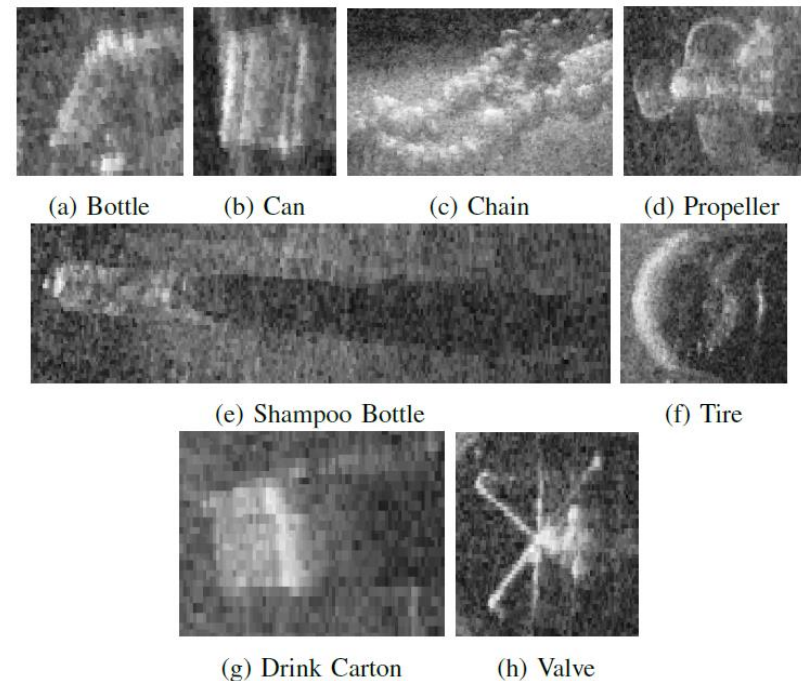
► Automatic Target Recognition (ATR) or sediment classification



(K. Denos, et al, 2017)



(D. Williams 2016)



(M Valdenegro-Toro, 2016)

Deep Learning from Shallow Dives

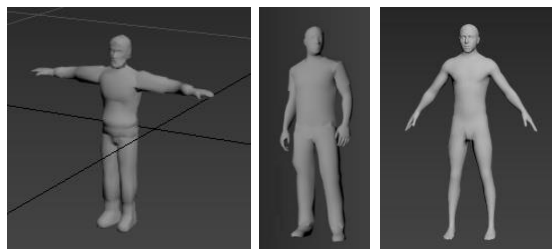
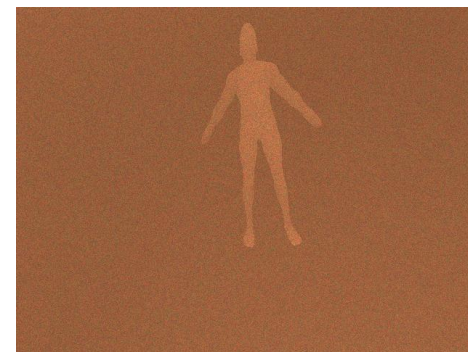
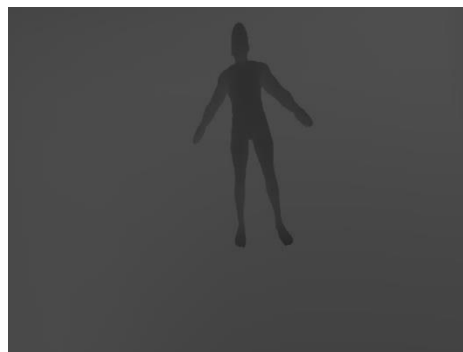
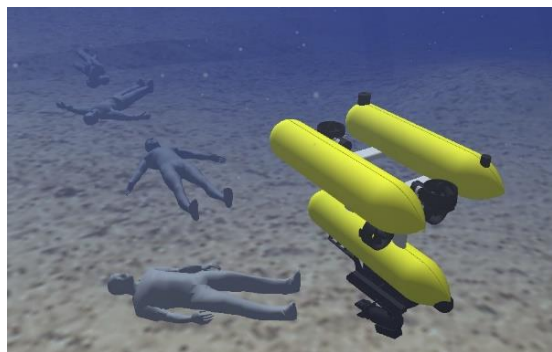


Q. How to secure enough data with label?

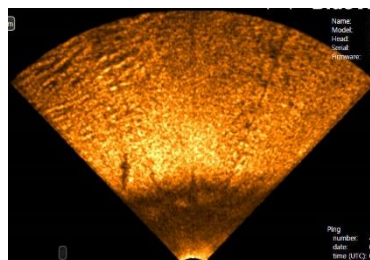
Deep Learning?



Overview



Training



Test with real sonar images



Data Augmentation

- ▶ Object might be brighter or darker
 - ▶ POOL and SEA has a different style
 - ▶ Invert intensity and normalize



- ▶ Rotation, translation, scale, flip



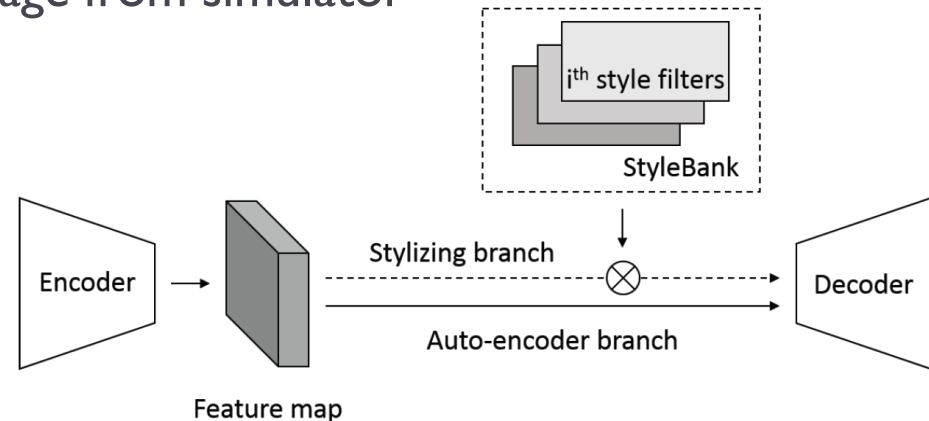


Stylized Sonar Images

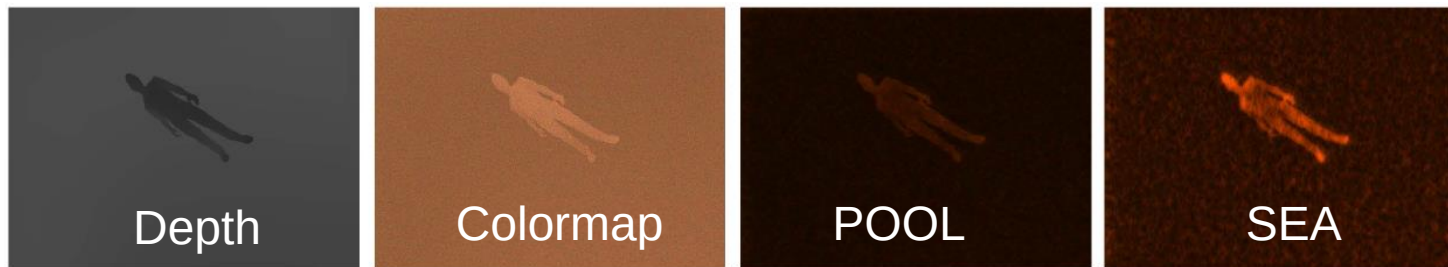
- ▶ Base image
 - ▶ Colormap changed depth image from simulator

- ▶ StyleBank[I]

- ▶ AE and style network
 - ▶ Multiple styles



- ▶ POOL & SEA styles for sonar



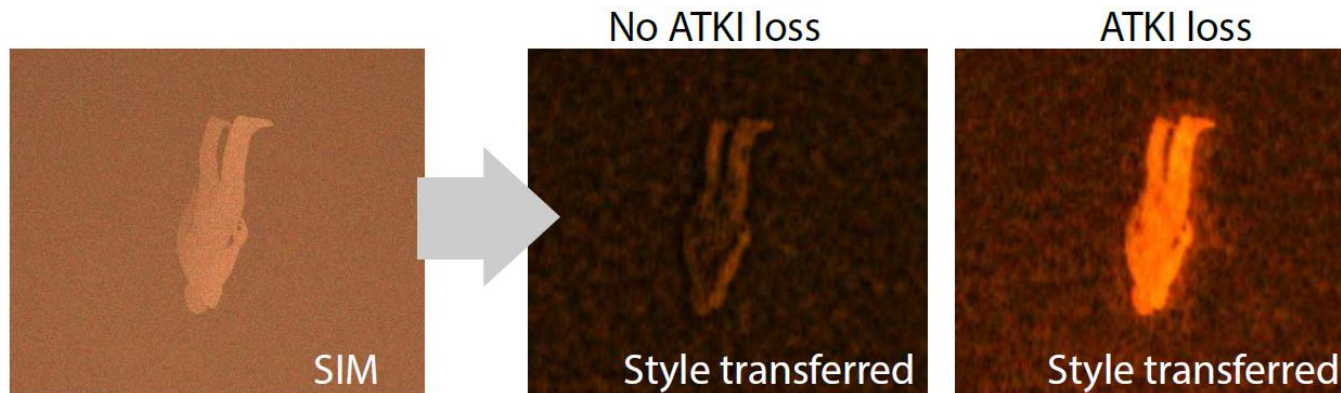


Loss for Stylization

- ▶ We introduce **ATKI loss** for sonar image

$$\mathcal{L}_{\mathcal{P}}(C, S_i, O_i) = \alpha \cdot \mathcal{L}_c(O_i, C_i) + \beta \cdot \mathcal{L}_s(O_i, S_i) + \gamma \cdot \mathcal{L}_{reg}(O_i) + \delta \cdot \mathcal{L}_{atki}(O_i, S_i),$$

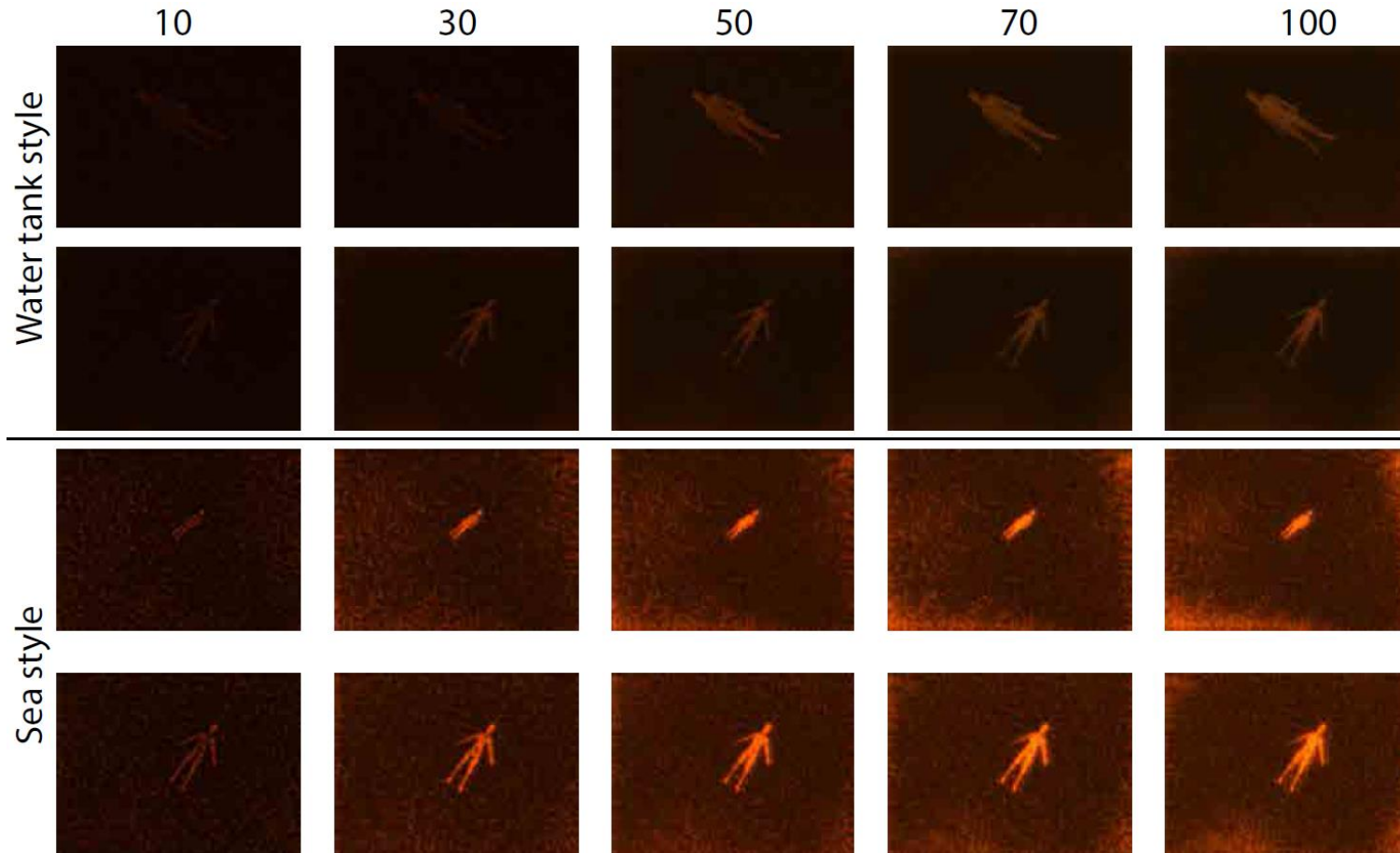
$$\mathcal{L}_{atki}(O_i, S_i) = \frac{1}{k} \sum_{j=1}^k \|O_{G_i}^{[j]} - S_{G_i}^{[j]}\|^2,$$





Training for Stylization

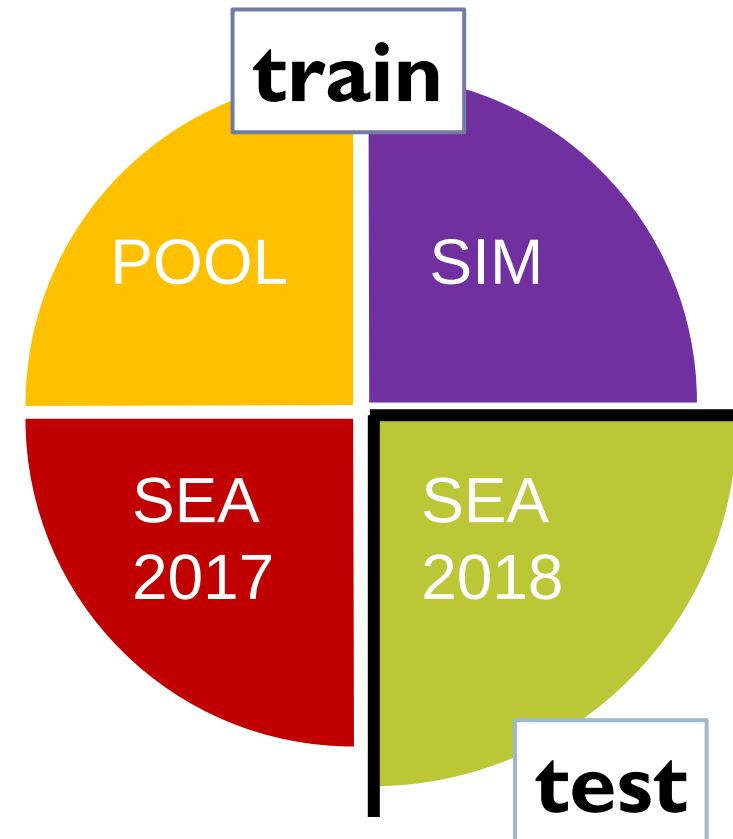
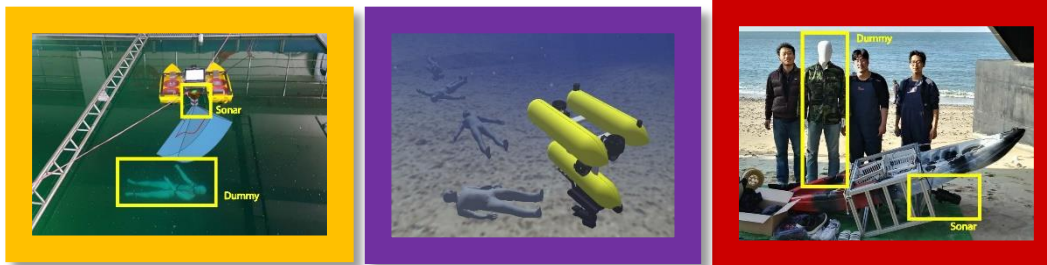
- ▶ Style is learnt for two styles (POOL and SEA)



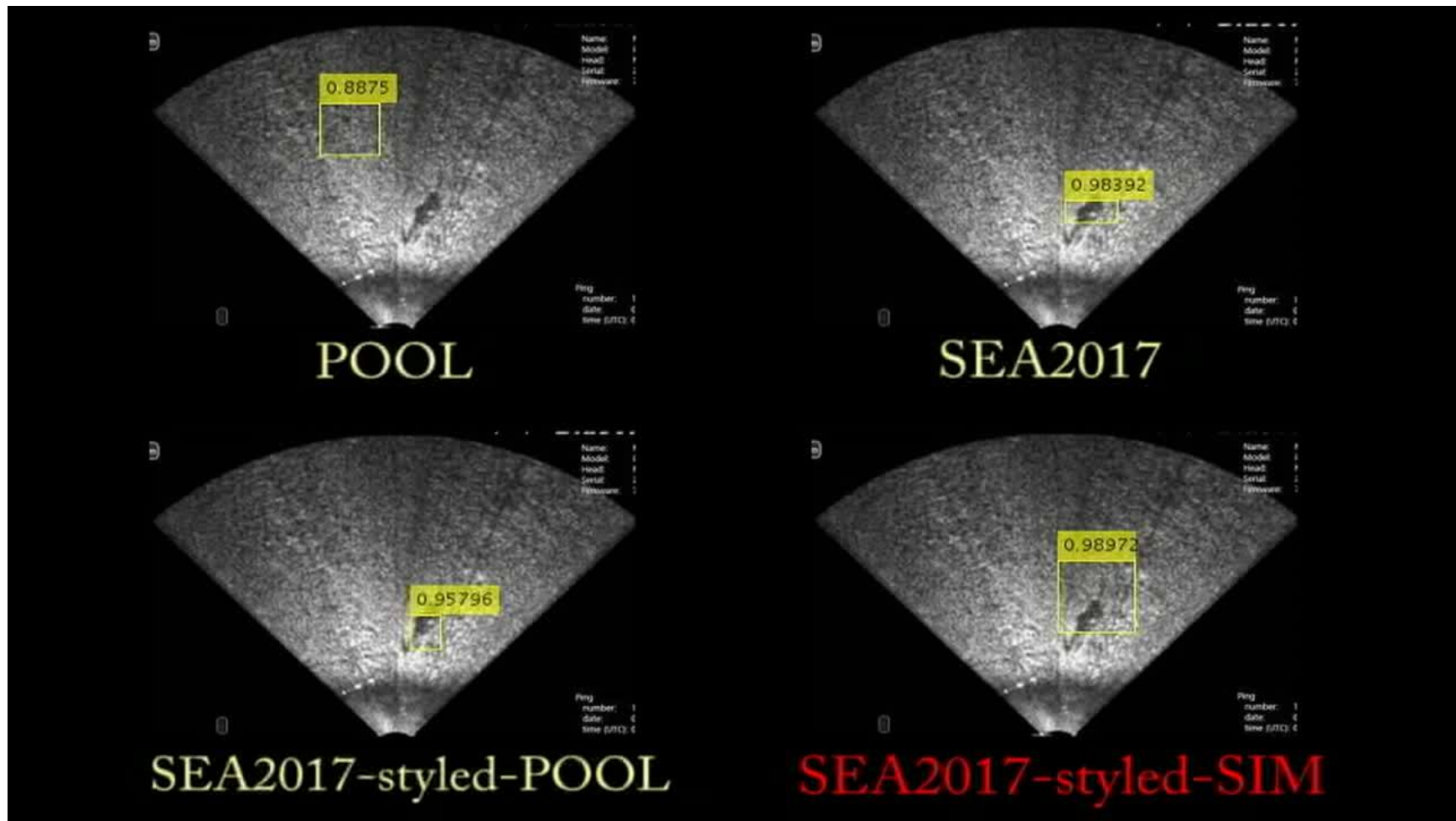


Datasets

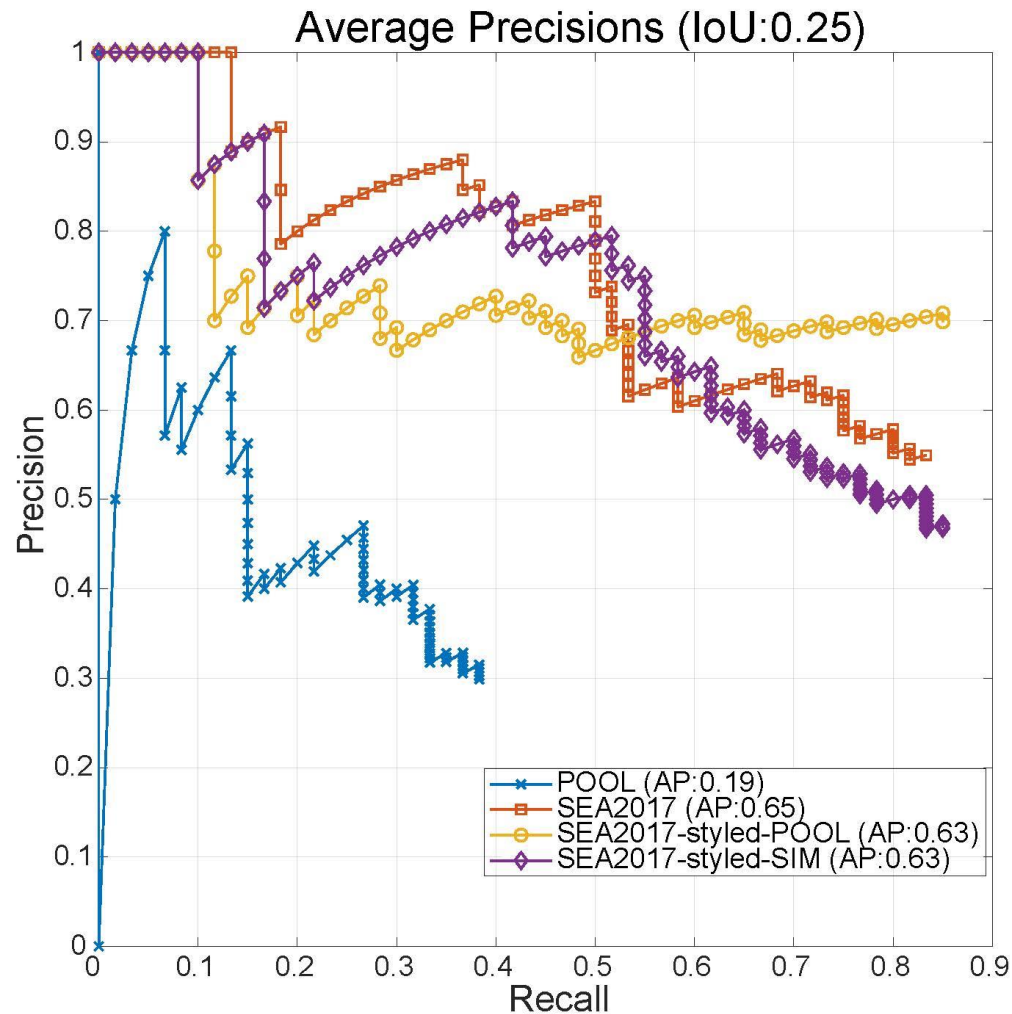
- ▶ SIM = simulator (#370)
- ▶ POOL = water tank (#735)
- ▶ SEA = near beach (#1045 & #1935)



Object Detection Performance



Object Detection



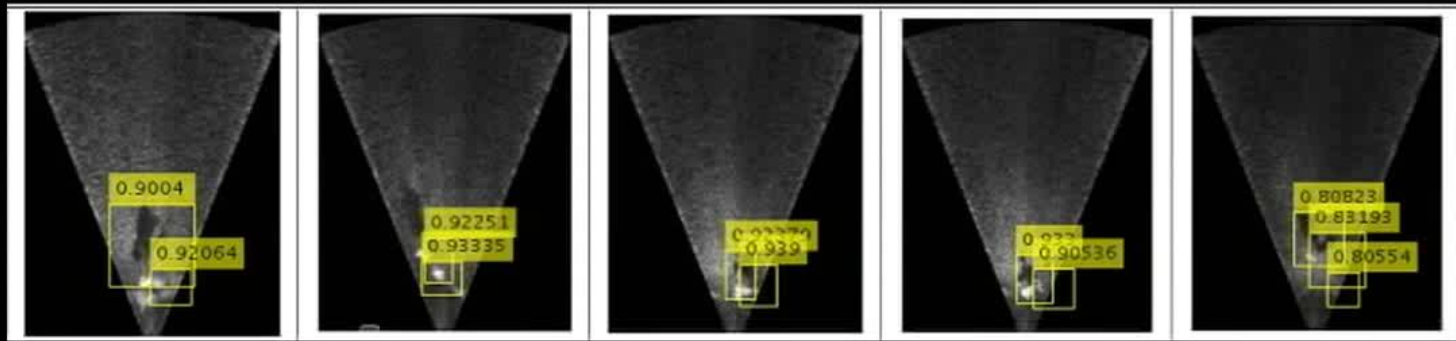
Test on Sample Sonar Video



Detected by SEA2017-styled-SIM

T1 - Teledyne (P900-45)

Diver standing sea floor



Acknowledgement



- ▶ This work was supported by NRF and MSIT



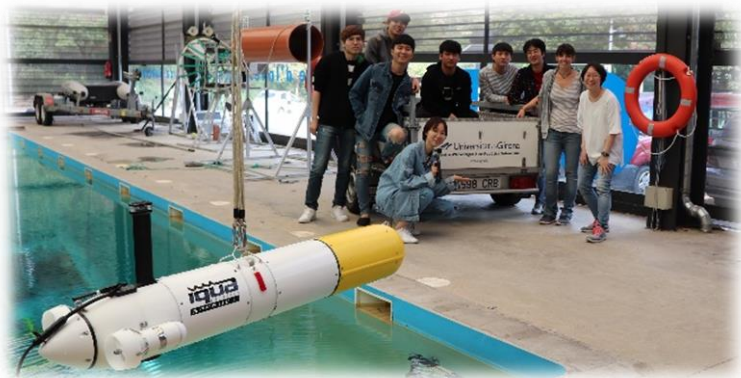
Ministry of Science and ICT

- ▶ Financial supports for students via u-city scholarship



- ▶ This work was supported by KRISO





Thank you very much !!

