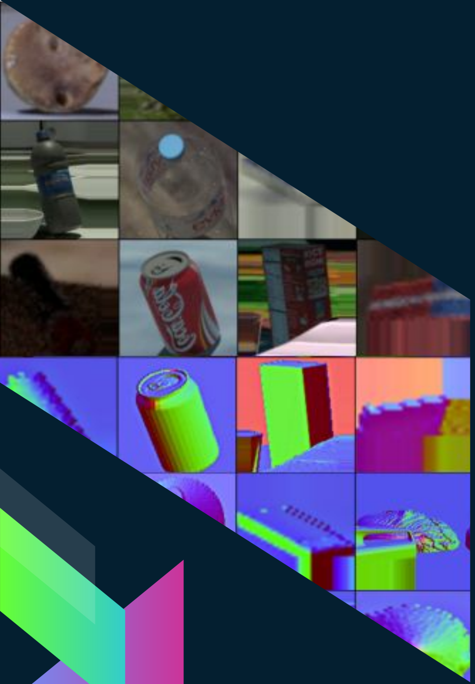
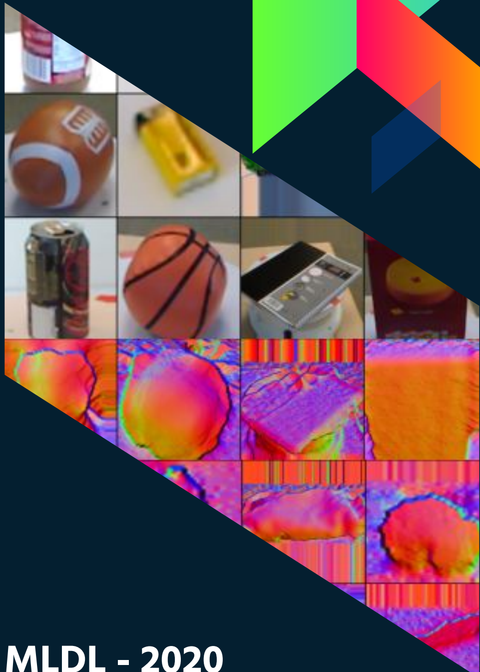


POLITECNICO
DI TORINO

Unsupervised Domain Adaptation through rotation as regression for RGB-D Object Recognition



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ABOUT THE PROJECT

- What is Domain adaptation?
- Why are we using RGB-D images?
- What are the tasks?
- What is our goal?

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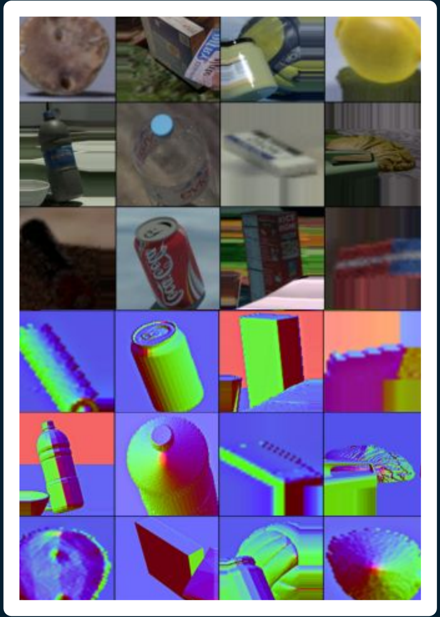
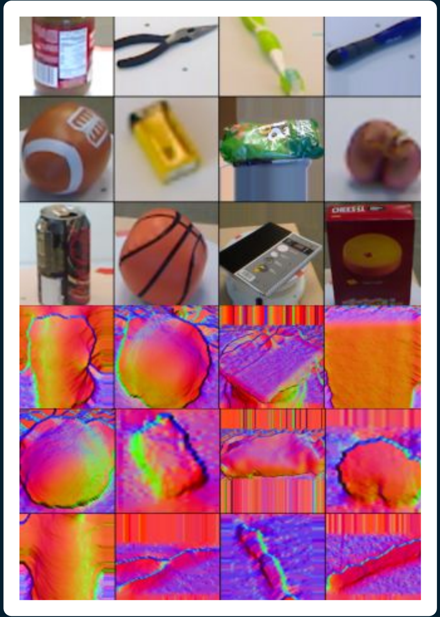
DATASET



SynROD as source domain



ROD as target domain

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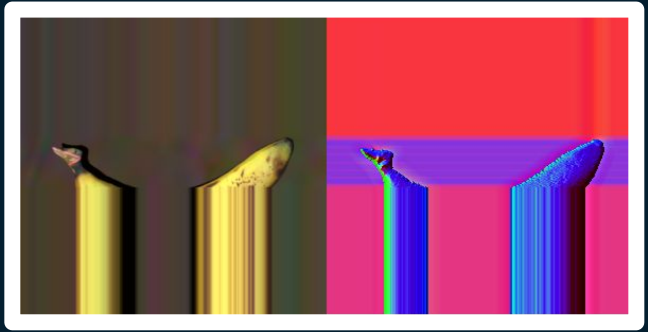
RELATED WORK

- Multy-modality CNN
- Image's stretch
- Color encoding for depth images
- Pretext task as artifact
- Loss entropy



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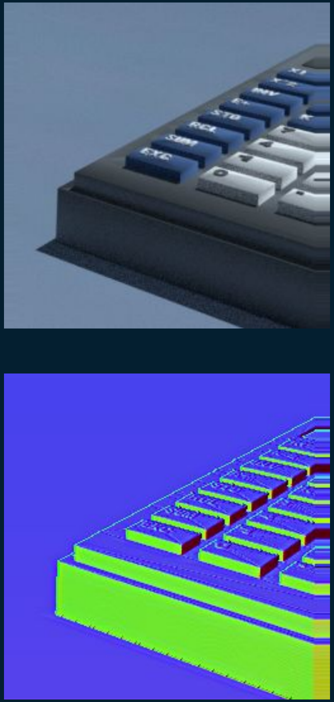
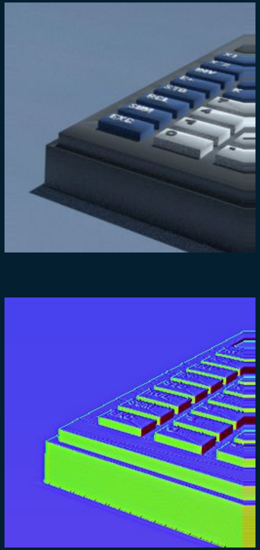
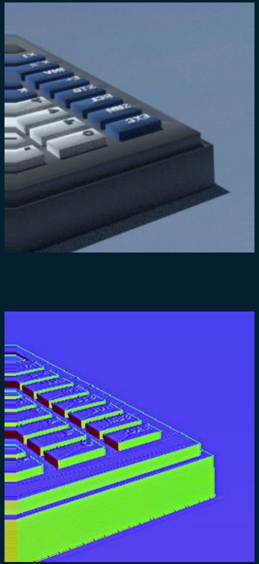
PREPROCESSING



Raw images



Resize to
256x256 px



Horizontal flip with
probability p=0.5

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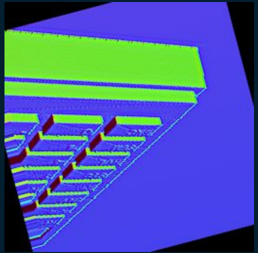
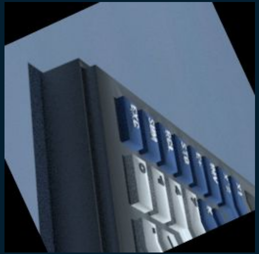
PREPROCESSING

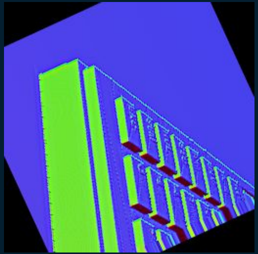
31.45°



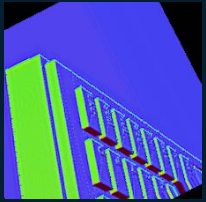
165.21°

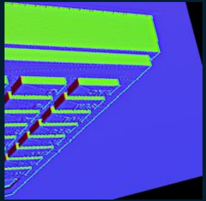
Relative rotation with 133.76°





Absolute rotation with 65.30°





Center Crop to
224x224 px

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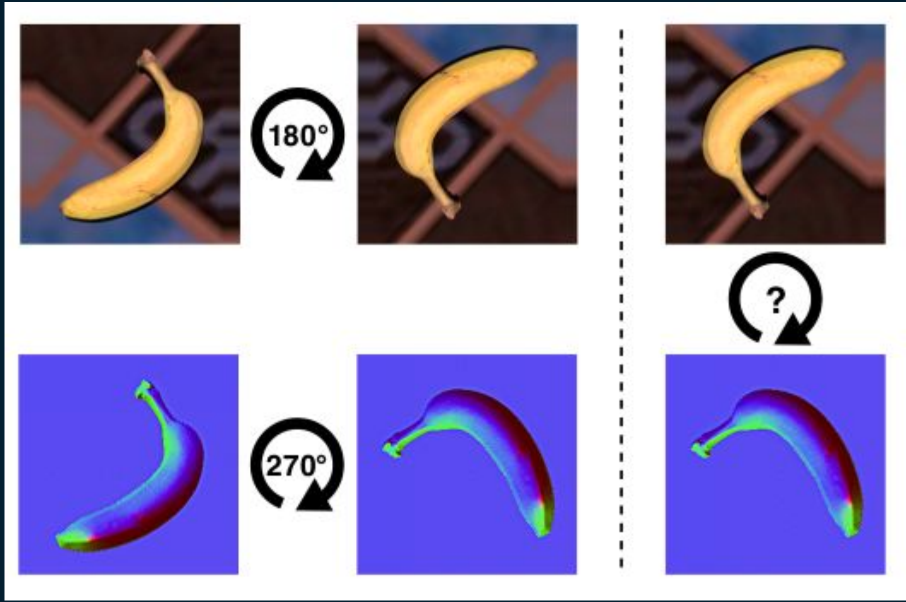
PRETEXT TASK



By how much should the RGB image be rotated to align with the depth image?

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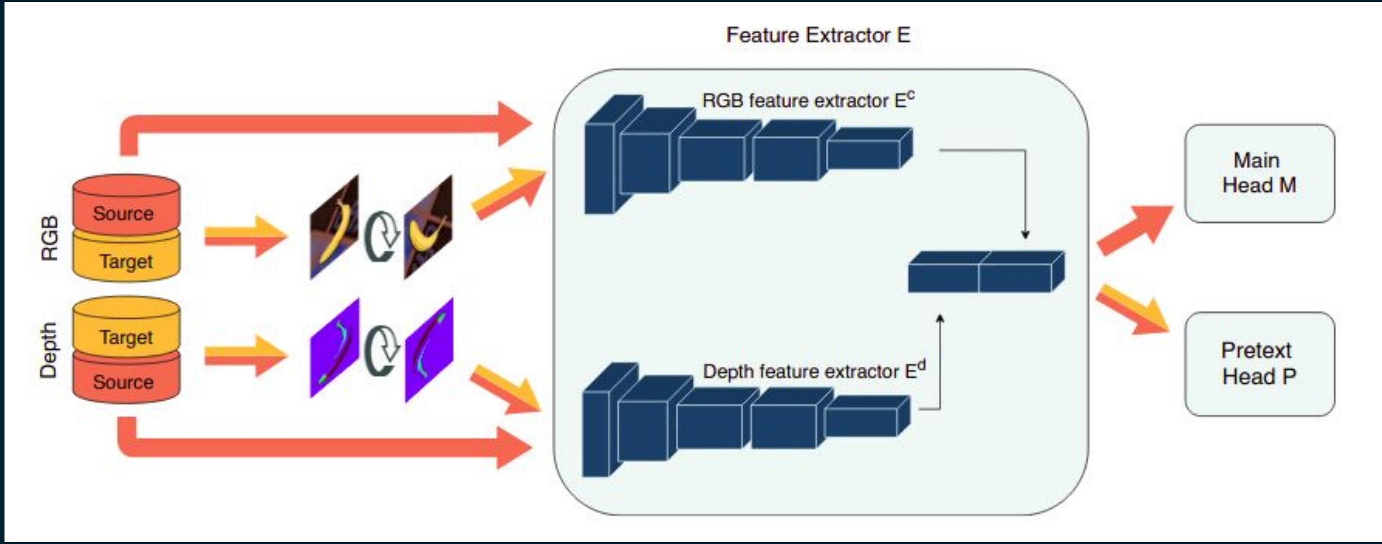
NETWORK ARCHITECTURE



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OPTIMIZATION PROBLEM

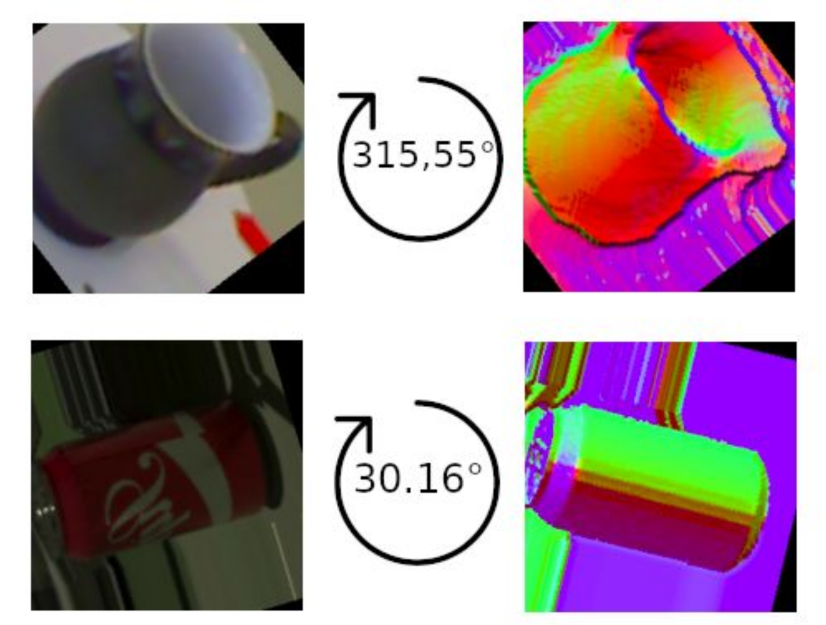
$$\mathcal{L} = \lambda_p \cdot \mathcal{L}_p + \mathcal{L}_M + \alpha \cdot \mathcal{L}_{en}$$

Cross-entropy pretext task

Cross-entropy main task

Loss entropy

OUR VARIATIONS



Absolute Rotation

Relative Rotation

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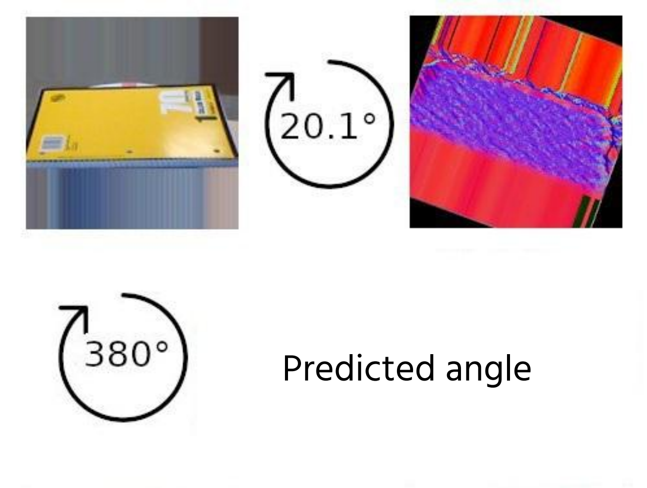
OUR VARIATIONS

Loss = (True angle - Predicted angle)^2



Loss = $(20.1° - 380°)^2 >> 0$

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ROTATION AS REGRESSION

- Using sine and cosine we can rewrite the problem as:

$$\vartheta \rightarrow (sin(\vartheta), cos(\vartheta))$$

- We can obtain the value of the angle in degrees using:

$$output \leftarrow atan2(sin_{predicted}, cos_{predicted})$$

- The new loss becomes:

$$\mathcal{L}_{regr} = \frac{1}{2}((sin_{pred} - sin(y))^2 + (cos_{pred} - cos(y))^2)$$

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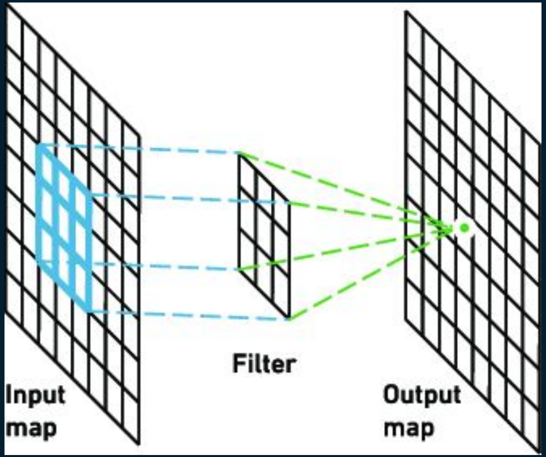
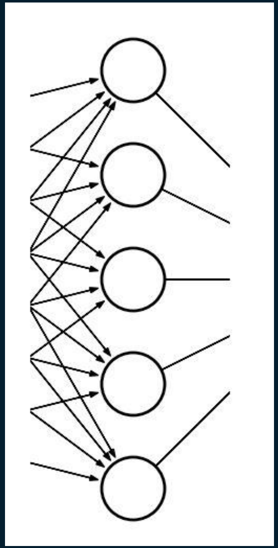
ROTATION AS REGRESSION

$$\mathcal{L} = \lambda_p(\underbrace{\mathcal{L}^S_{sin} + \mathcal{L}^S_{cos}}_{\text{MSE losses for the samples taken from the source domain}} + \underbrace{\mathcal{L}^T_{sin} + \mathcal{L}^T_{cos}}_{\text{MSE losses for the samples taken from the target domain}}) + \underbrace{\mathcal{L}_M}_{\text{Cross-entropy main task}} + \alpha \cdot \underbrace{\mathcal{L}_{en}}_{\text{Loss entropy}}$$

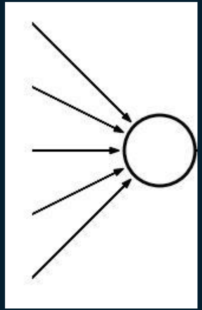
PRETEXT HEAD



2 convolutional layers



Fully connected with
100 neurons



Output neuron

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EXPERIMENTS

RGB
DEPTH

RGB-D e2e

Loghmani et al.
cross-modality
algorithm

Source only

Absolute and relative
rotation as regression

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Giammarinaro Silvia

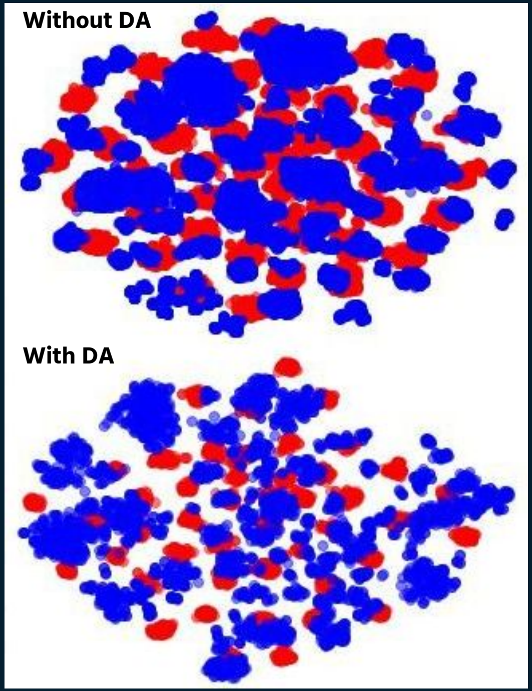
RESULTS

POLITECNICO
DI TORINO

Method	Modality	synROD $\rightarrow$ ROD
Source only	RGB Depth RGB-D e2e	51.4% 13.1% 47.9%
Loghmani et al. impl.	RGB-D	57.6% ± 1.2%
Abs. rotation as regression	RGB-D	55% ± 0.9%
Rel. rotation as regression	RGB-D	59% ± 0.8%

CONCLUSIONS

- t-SNE algorithm
- Other trials
  - Different color encoding
  - Noise patterns
  - ARID dataset



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THANKS FOR YOUR ATTENTION!

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Giammarinaro Silvia

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