On Object Symmetries And 6D Pose Estimation From Images

Giorgia Pitteri
University of Bordeaux

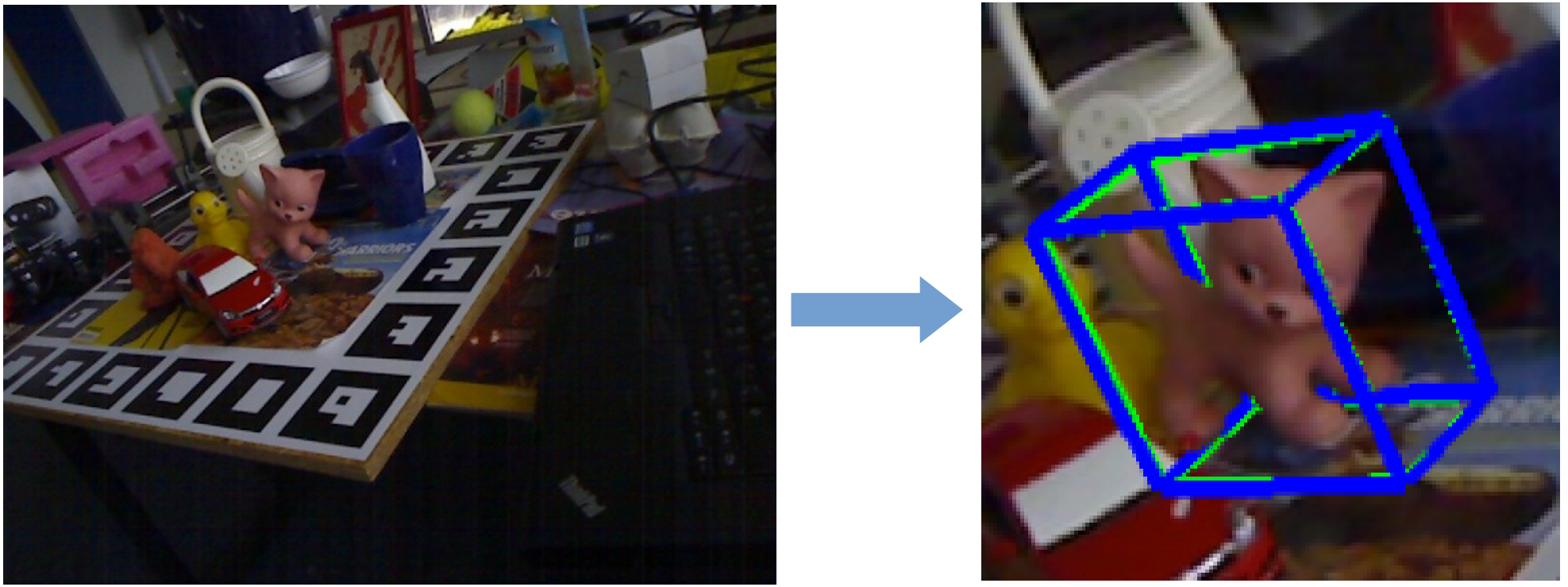
September 19, 2019
3DV spotlight session

Joint work with: Michaël Ramamonjisoa, Slobodan Ilic and Vincent Lepetit

université de BORDEAUX LaBRI

SIEMENS
Ingenuity for life

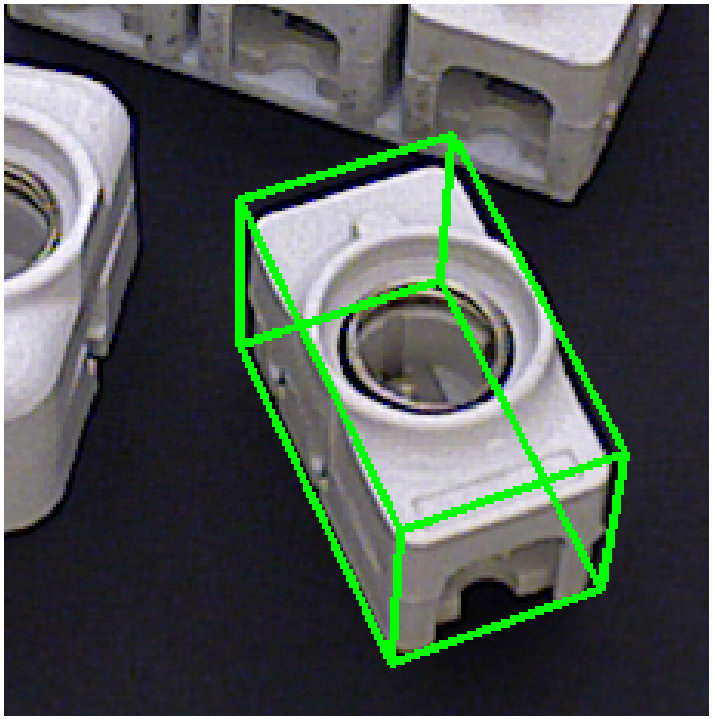
6D Pose Estimation From Images

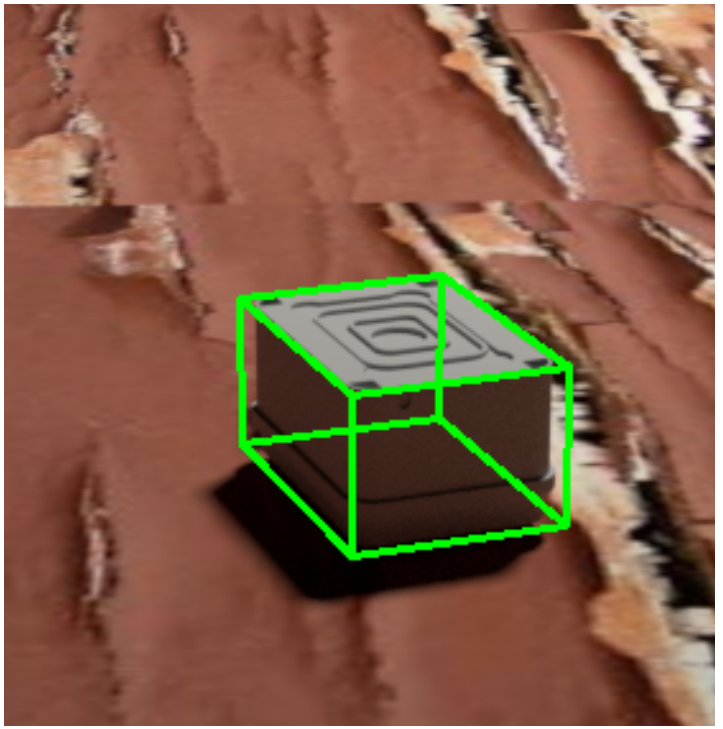


$$Loss = \sum_{samples} loss\left(GroundTruthPose, PredictedPose\left(image\right)\right)$$

6D Pose Estimation From Images

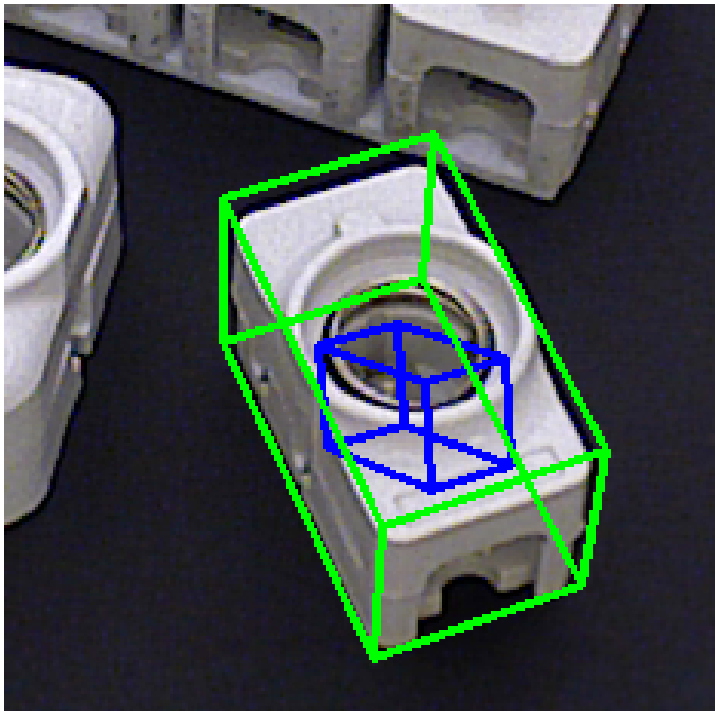
- **Challenge:** symmetrical and quasi-symmetrical objects:

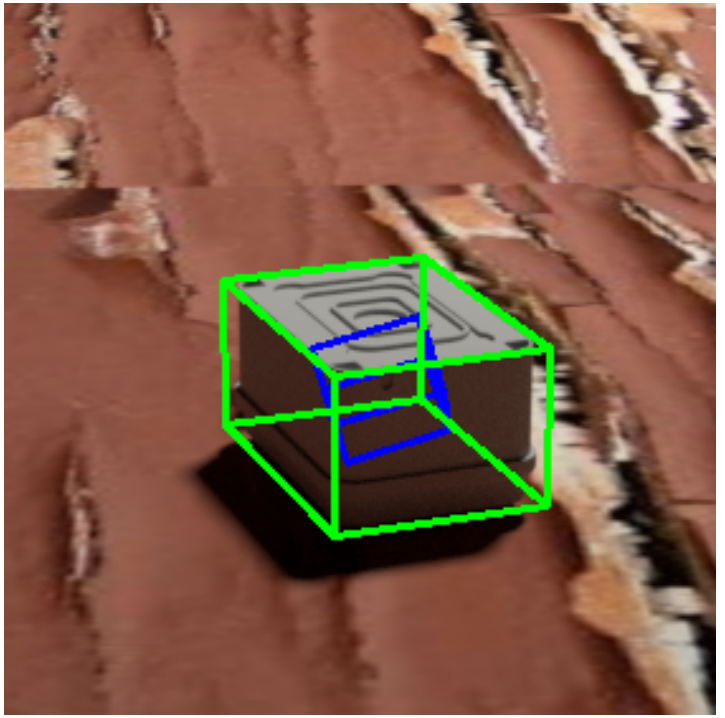




6D Pose Estimation From Images

- **Challenge:** symmetrical and quasi-symmetrical objects:

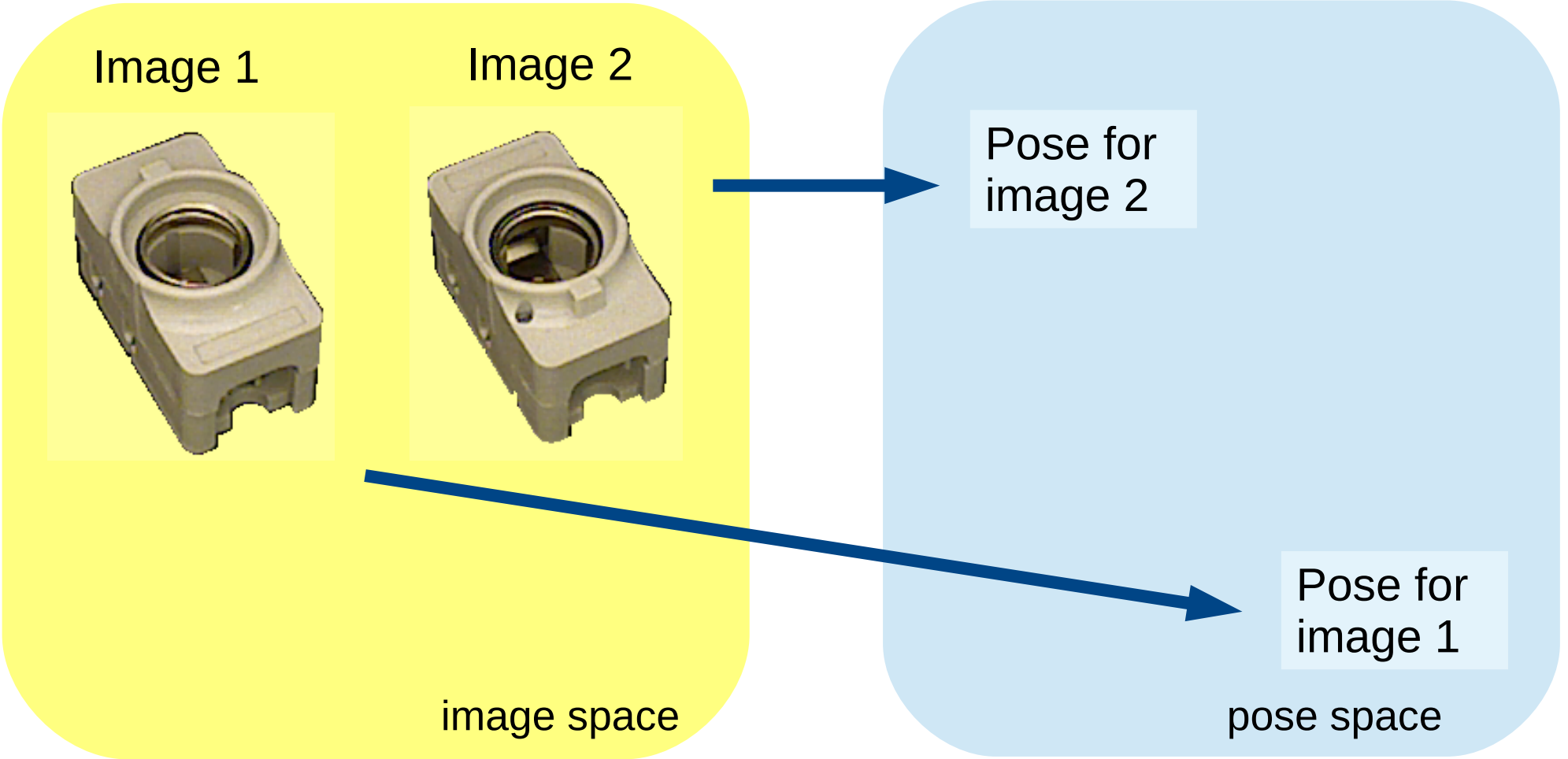




Deep Networks fail with symmetrical and quasi-symmetrical objects

Problem

$$Loss = \sum_{samples} loss\left(GroundTruthPose\ , PredictedPose\left(image\right)\right)$$



$F : Image \rightarrow pose$ is NOT a 1-1 mapping

Recent Works

- M. Rad, V. Lepetit, **BB8: A Scalable, Accurate, Robust to Partial Occlusion Method for Predicting the 3D Poses of Challenging Objects Without Using Depth,** [ICCV ‘17]
- M Sundermeyer, Z. C. Marton, M Durner, M Brucker, R Triebel, **Implicit 3D Orientation Learning for 6D Object Detection from RGB Images**, [ECCV ‘18]
- F. Manhardt, D. M. Arroyo, C. Rupprecht, B. Busam, T. Birdal, N. Navab, F. Tombari, **Explaining the Ambiguity of Object Detection and 6D Pose from Visual Data**, [arXiv ‘18]
- R. Brégier, F.Devernay, L.Leyrit, J. L. Crowley, **Defining the Pose of Any 3D Rigid Object and an Associated Distance** [IJCV ‘18]

Our Contribution (1)

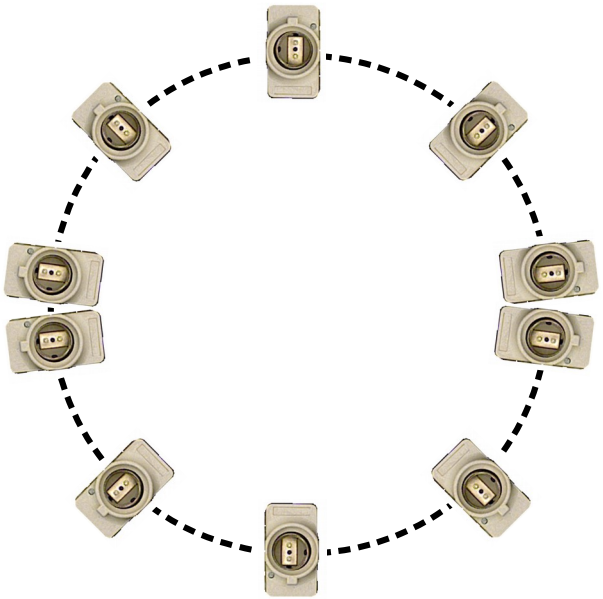
- we explain the link between the symmetries of a 3D object and its appearances in images

Our Contribution (2)

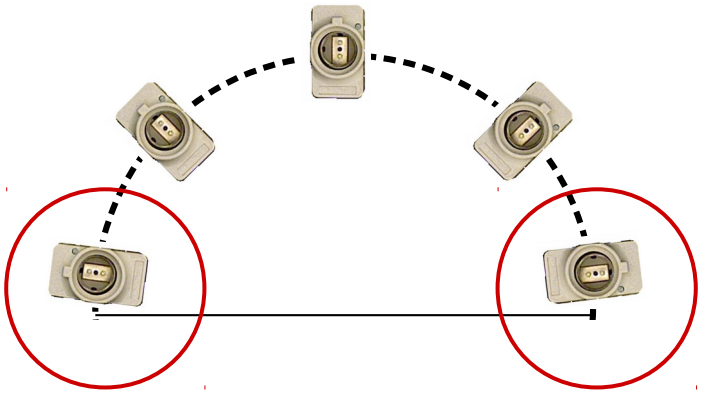
- we explain the link between the symmetries of a 3D object and its appearances in images

- we show why restricting the poses within some ranges is not enough

full pose space



restricted pose space



$$F : Image \rightarrow pose$$

still not a 1-1 mapping

Our Contribution (3)

- we explain the link between the symmetries of a 3D object and its appearances in images

- we show why restricting the poses within some ranges is not enough

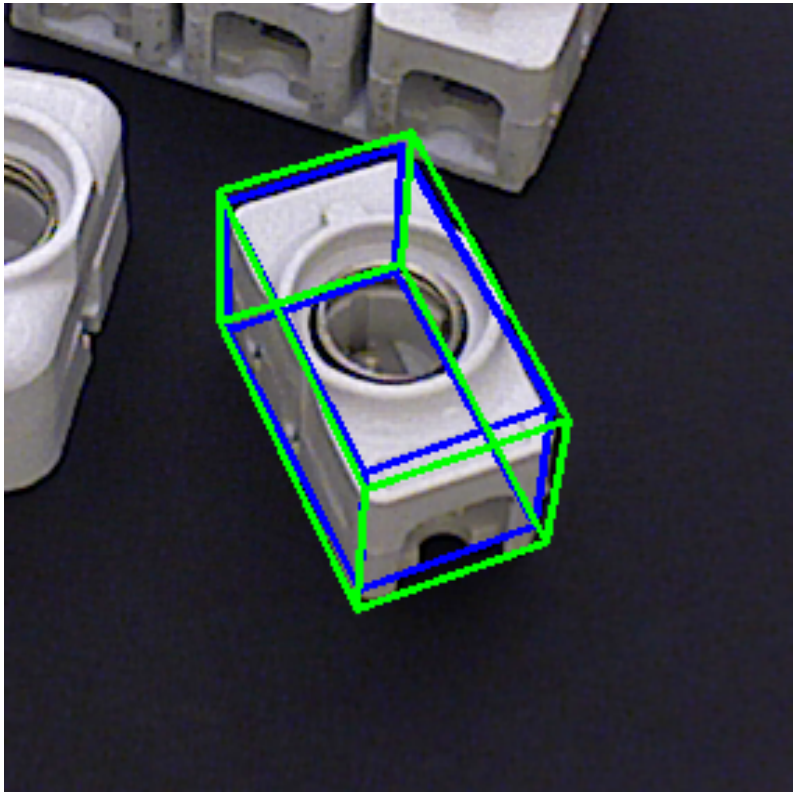
- we provide a simple and analytical solution to handle the problem based on the normalization of the pose rotation

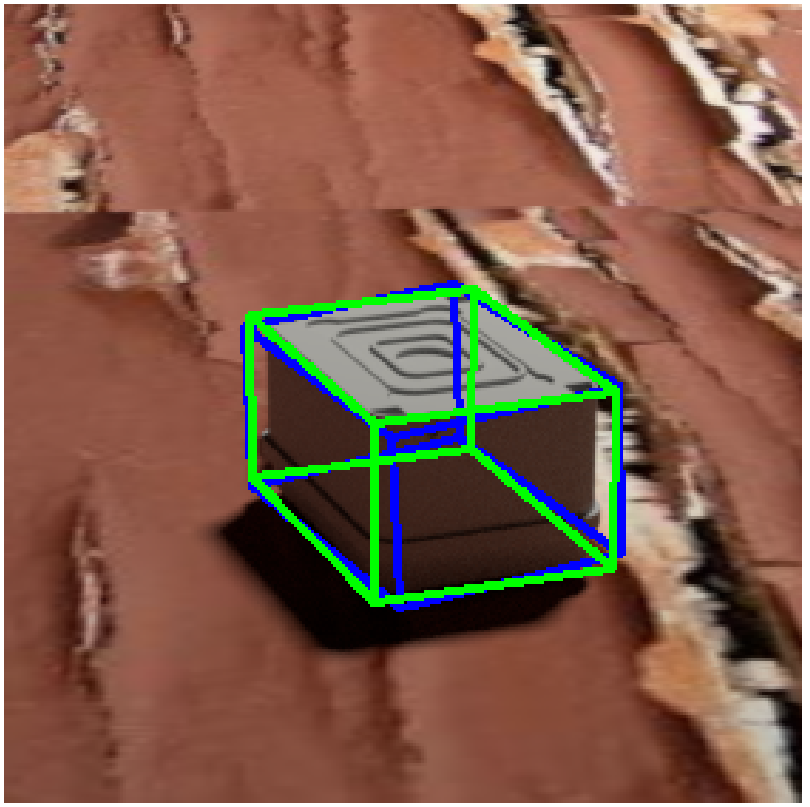
Our Contribution (4)

- we explain the link between the symmetries of a 3D object and its appearances in images
- we show why restricting the poses within some ranges is not enough
- we provide a simple and analytical solution to handle the problem based on the normalization of the pose rotation
- we integrate our method into a Faster R-CNN based pose estimation framework and evaluate it on the challenging T-LESS dataset

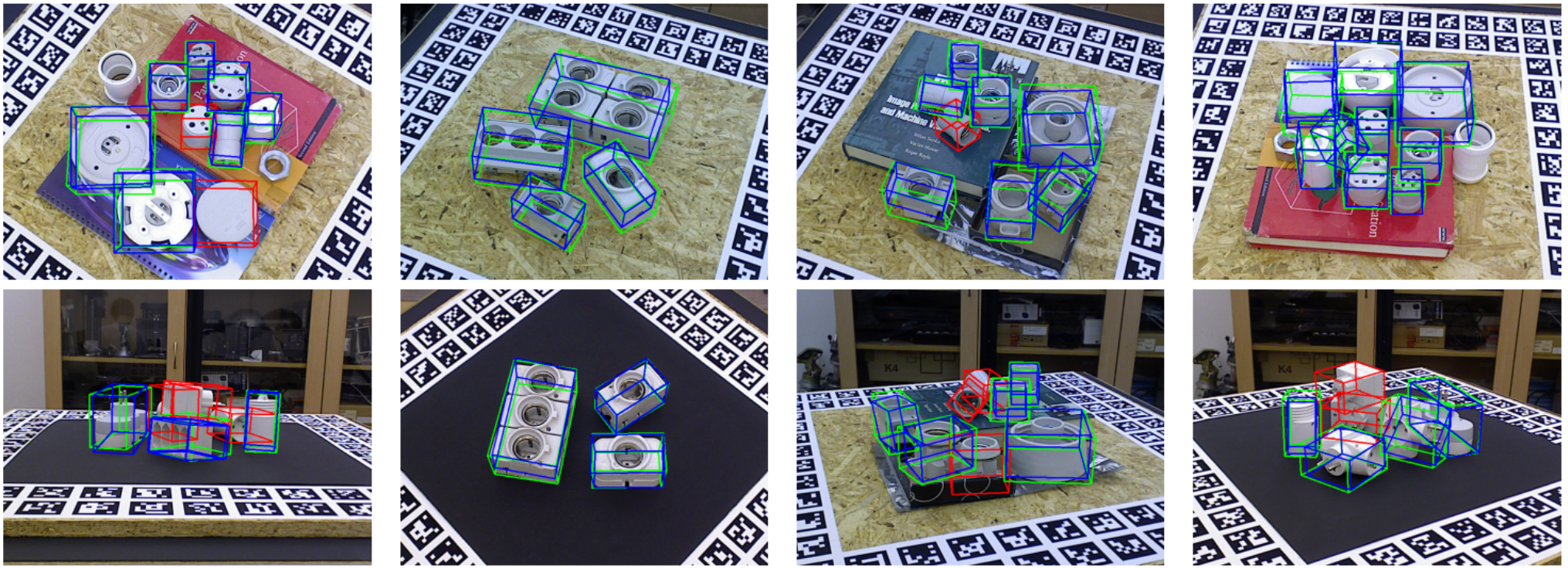
Results

Effectiveness of our normalization approach





Results On T-LESS



Ground truth poses in green
Predicted poses in blue
Missed detections in red

Thank you!

Please come to our poster for more details and results
Poster ID: 202