



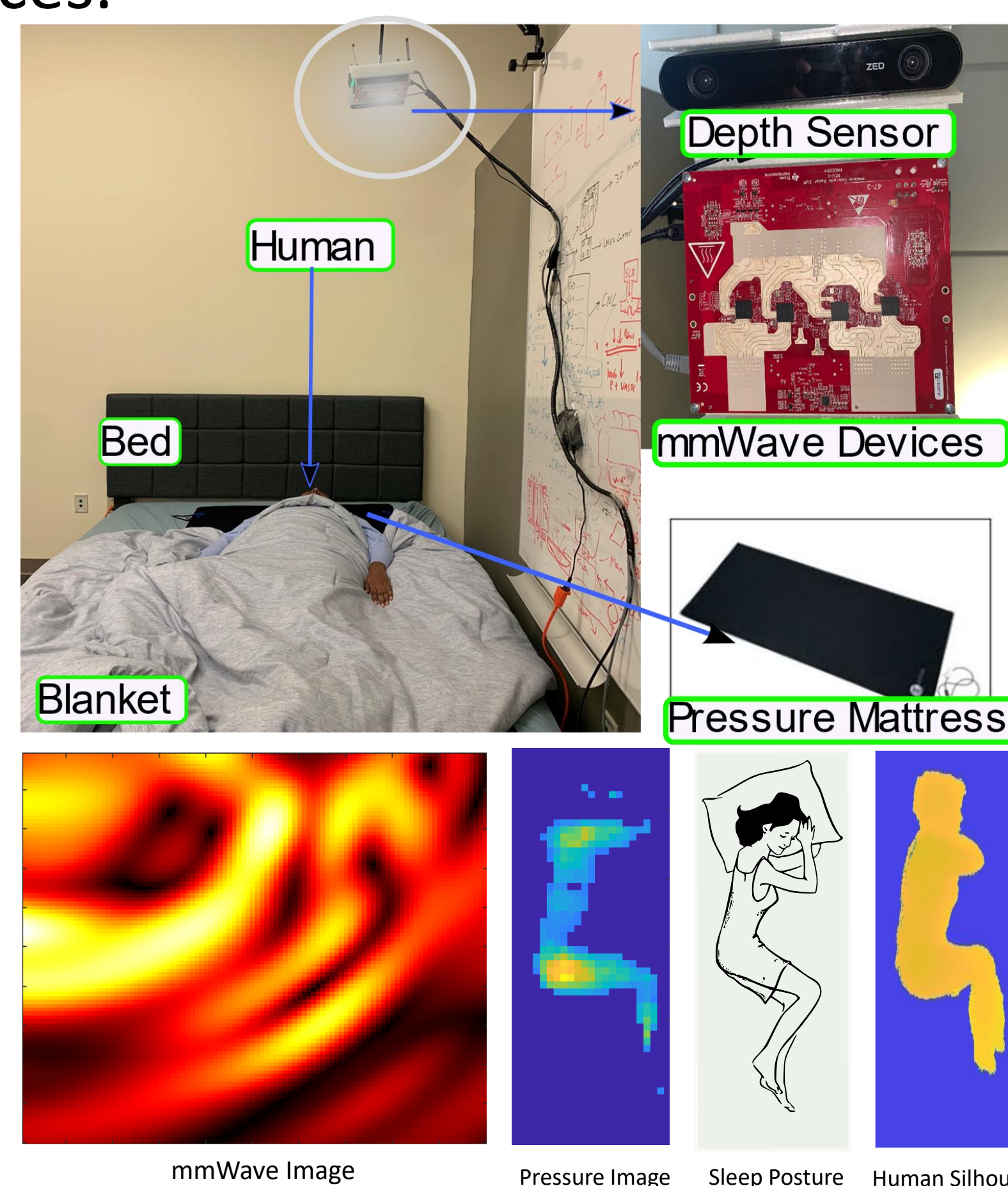
## Objective and Challenges

### Motivation for Sleep Posture Monitoring

- Facilitate sleep posture monitoring which can provide insights into improving sleep quality and preventing negative health outcomes.
- Enable **imaging of a person's body** during sleep, even if they are **covered by a blanket**, using 5G millimeter-wave (mmWave) devices.
- Enable **at-home sleep posture monitoring** without being intrusive and privacy-invasive.

### Millimeter-Wave Challenges

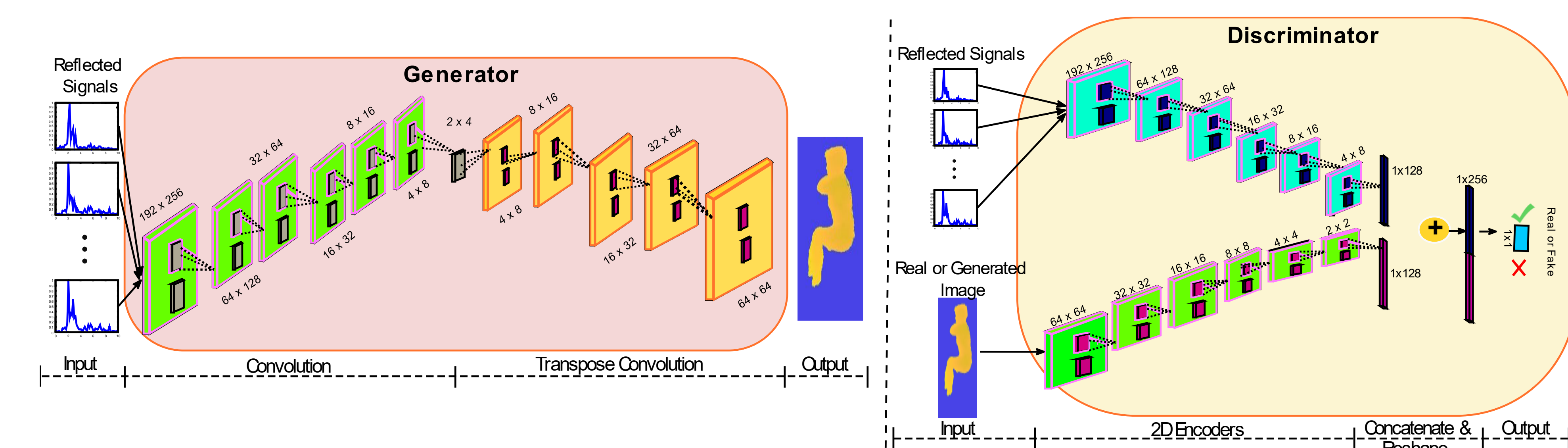
- Compared to vision systems, mmWave devices have **lower resolution**.
- Signal specularity** and variable reflectivity create Imperceptible images.



## cGAN for Silhouette Generator

### Overcoming the challenges in mmWave imaging via the cGAN framework

- Conditional Generative Adversarial Network (cGAN) learns the association between mmWave reflected signals and the 2D ground truth images.
- Generator and Discriminator are trained in an adversarial way.

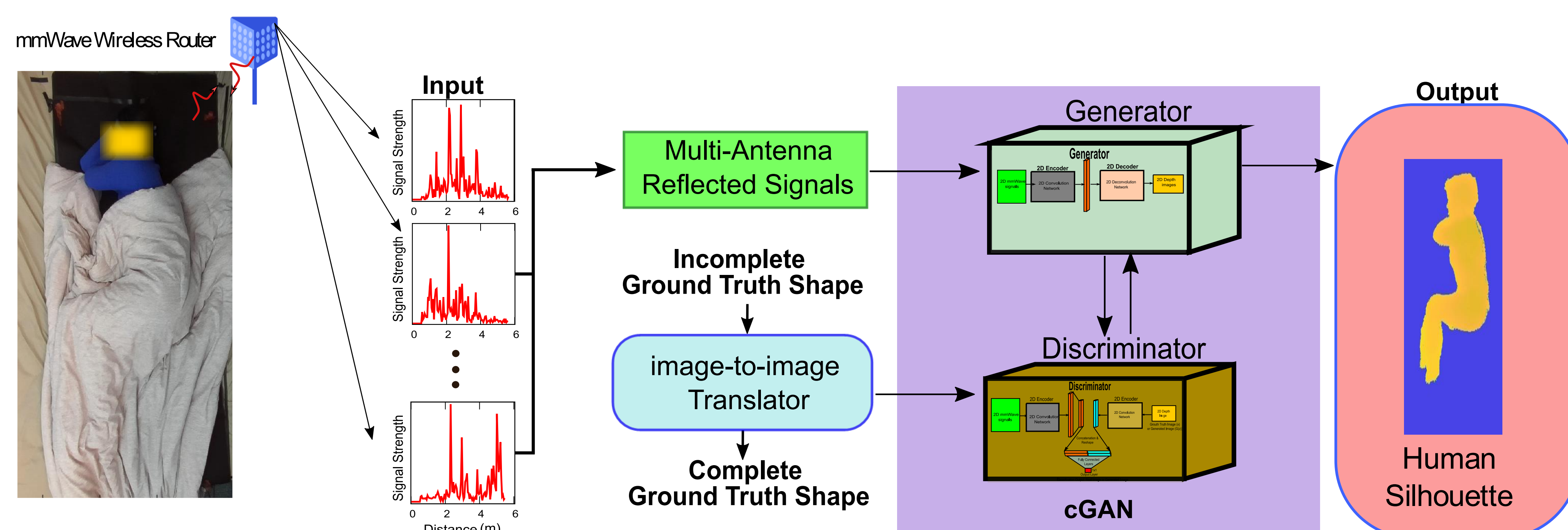


- cGAN can capture sleep postures, whether or not a blanket is present.
- During deployment, *MatGAN* generates images using only the reflected signals.

## Image-to-Image Translator

### Filling in the missing information in ground truth

- Mattress can only sense the body parts in contact with the surface.
- Ground truth images from pressure mattress are incomplete.

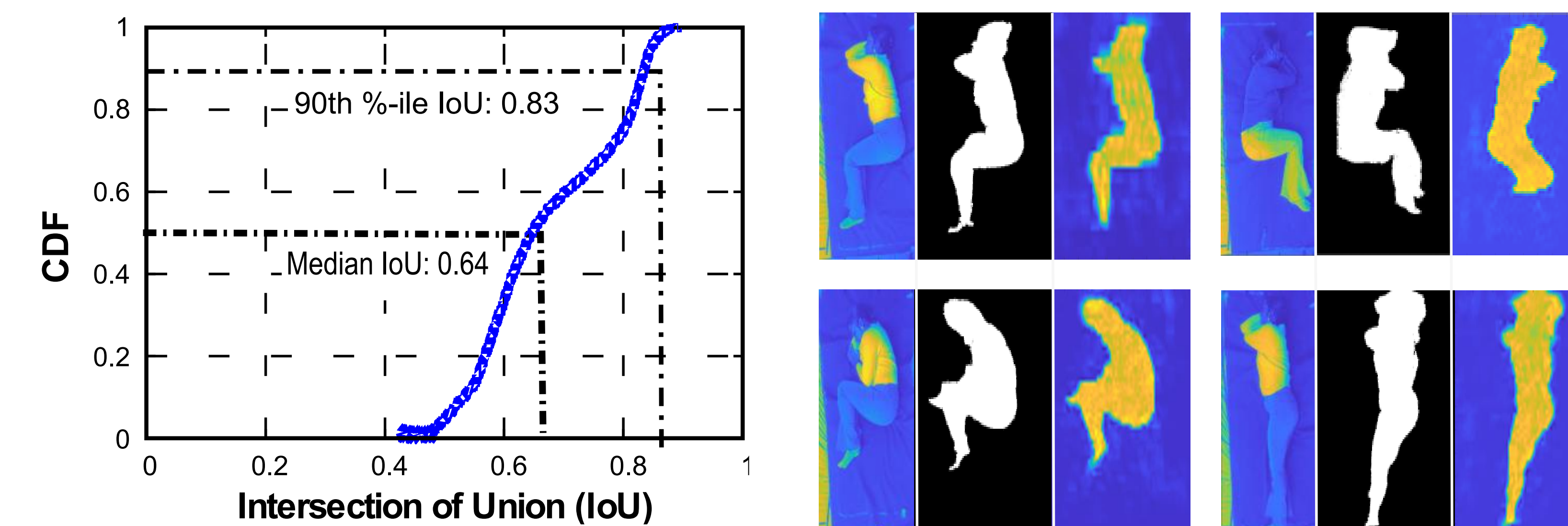


- MatGAN* fills in the missing information via an image-to-image translator that imputes the missing information using 2D images from the camera.
- During run-time, we utilize a pre-trained cGAN and do not need a mattress.

## Preliminary Results and Conclusion

### Sleep Posture Prediction

- MatGAN* generates 2D images (without blanket) with a median IoU of 0.64 and a 90th percentile IoU of 0.83 for diverse sleep postures with 3000 samples.



### Conclusion

- MatGAN* enables sleep posture imaging comparable to vision-based systems.

### Future works

- Conduct long trials to assess end-to-end system performance.
- Conduct field trials with multiple diverse set of volunteers.

