

電機資訊學院 2021 作 BRAIN PLUS HAND 實作專題競賽

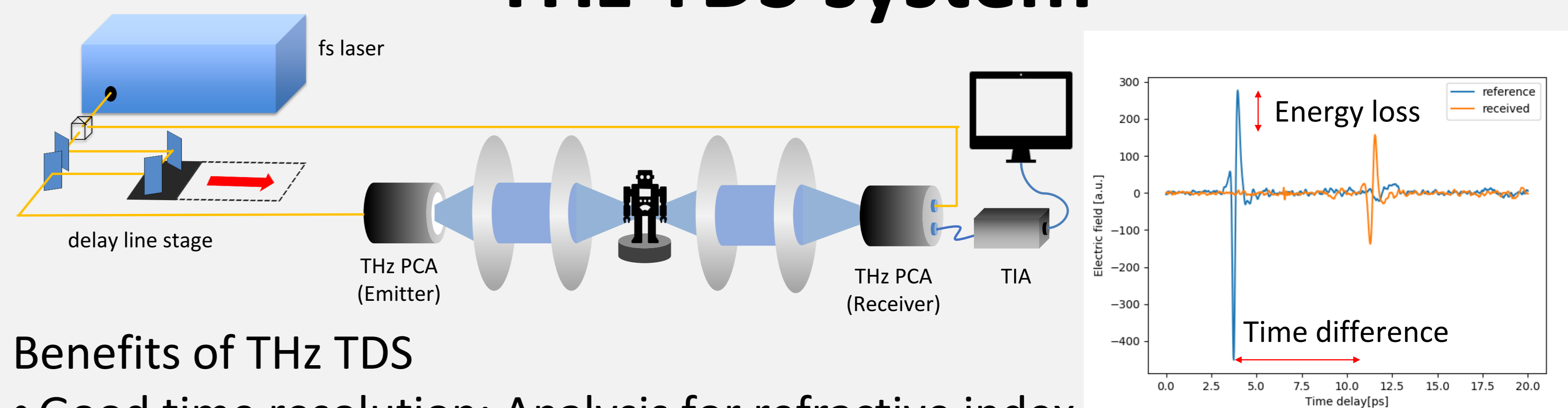
Terahertz Deep Learning Super Resolution Imaging Training on Sinogram

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Introduction

Accelerating the Terahertz computed tomography (THz CT) system by reducing total number of sampling point would decrease the image quality and some unexpected artifact would emerge. We presented a supervised deep learning method to decrease acquisition time and to suppress terahertz image artifact levels based on sinogram from terahertz time domain spectroscopy (THz-TDS). Our method delivered superior image quality than conventional bicubic interpolation method.

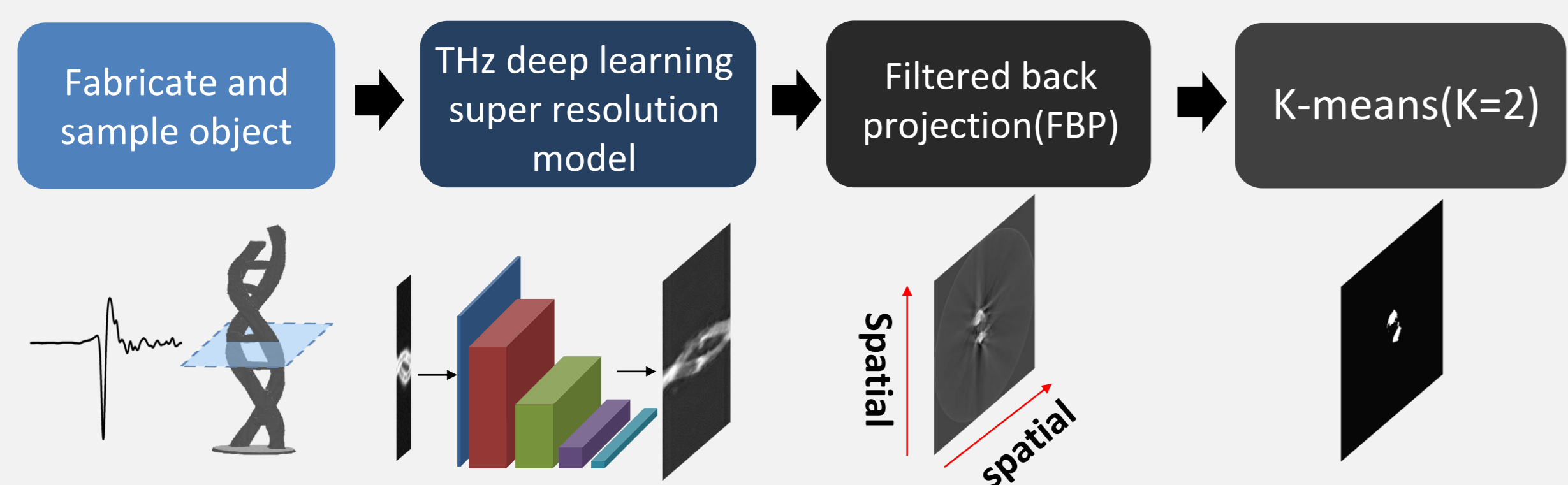
THz TDS system



Benefits of THz TDS

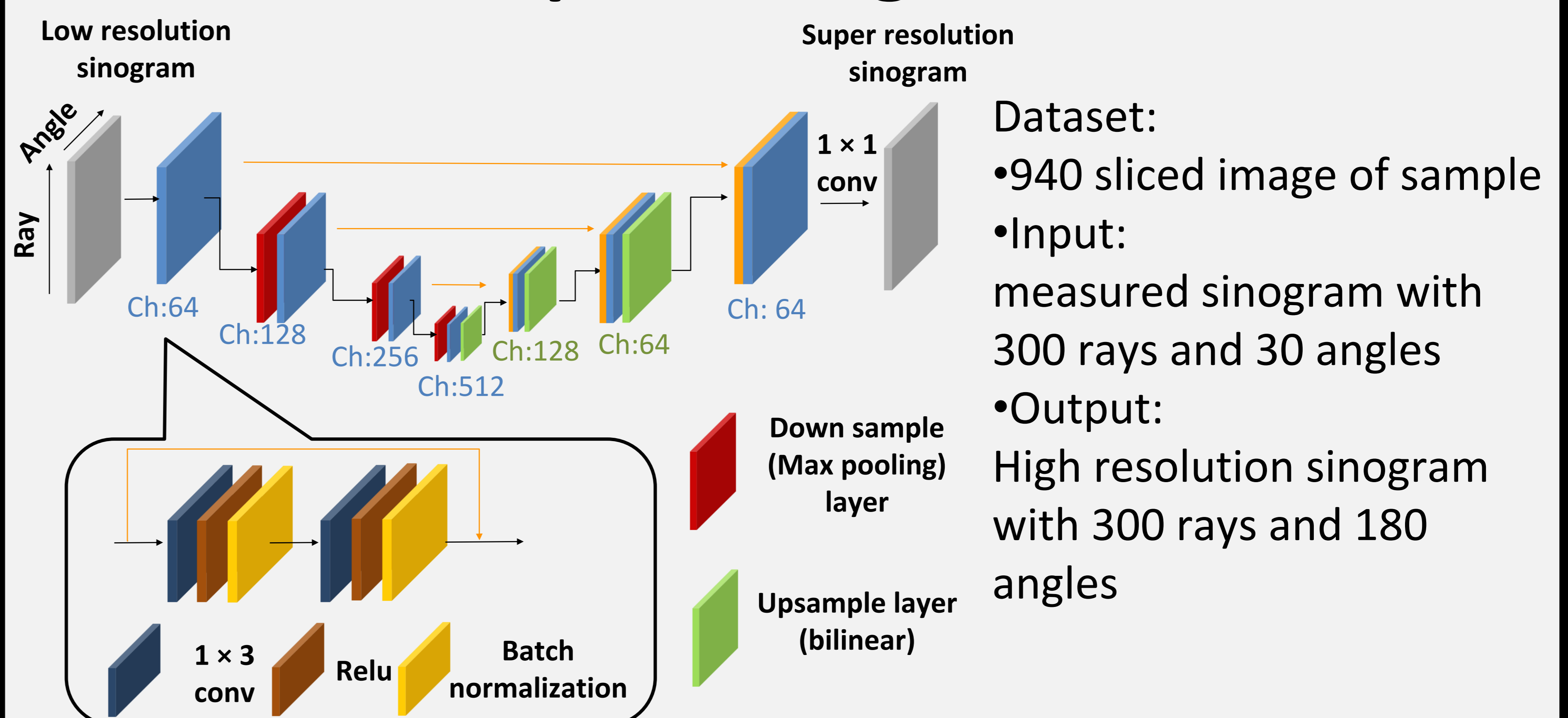
- Good time resolution: Analysis for refractive index
- Broad band signal: Available for Spectral analysis
- Unique light matter interaction

System Design

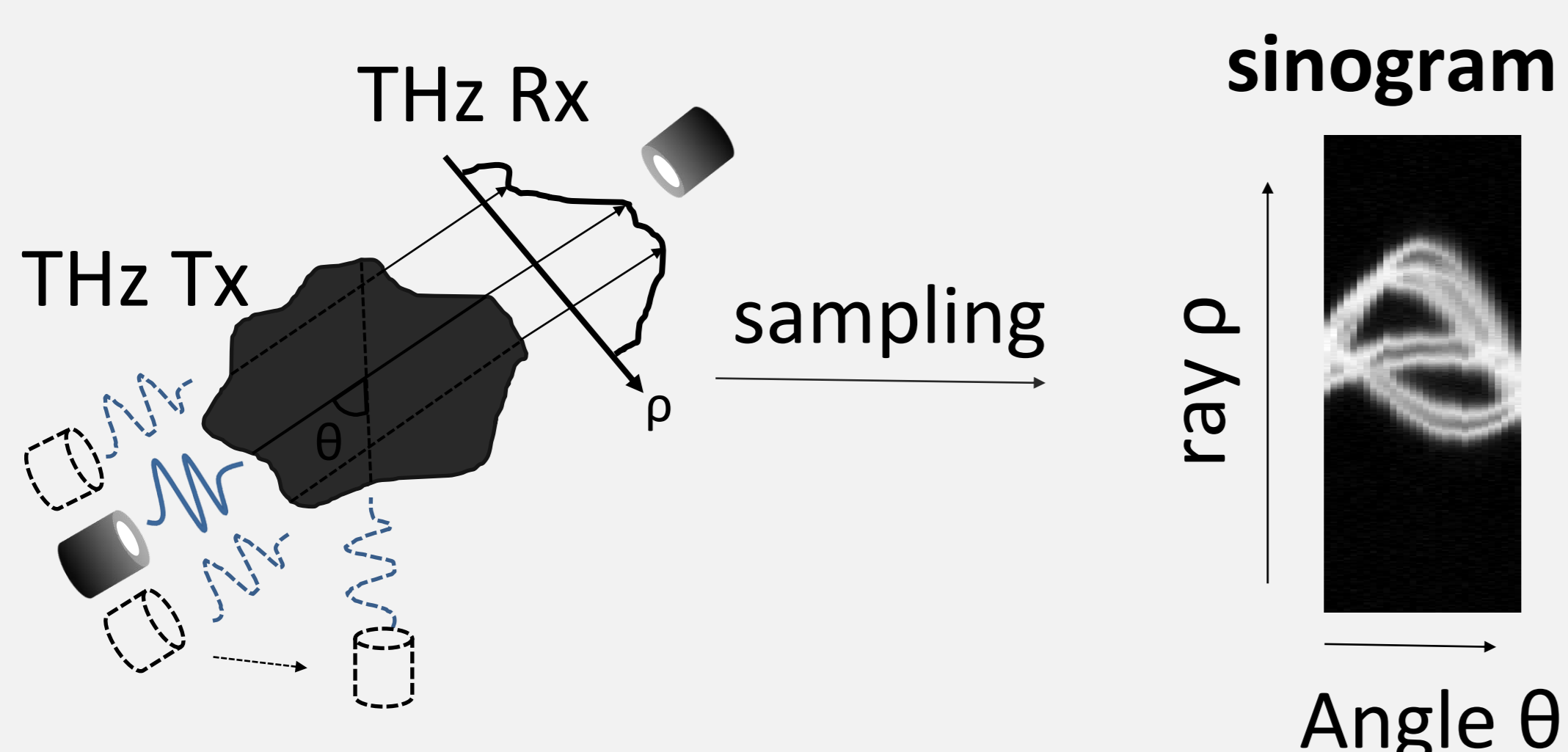


1. Fabricate and sample the objects by raster scanning with THz TDS system. All training objects are printed by high impact polystyrene (HIPS).
2. Use deep learning model to upsample and denoise the sinogram.
3. Transform the sinogram to THz CT-image
4. Split the slice image into two groups.

Deep learning model

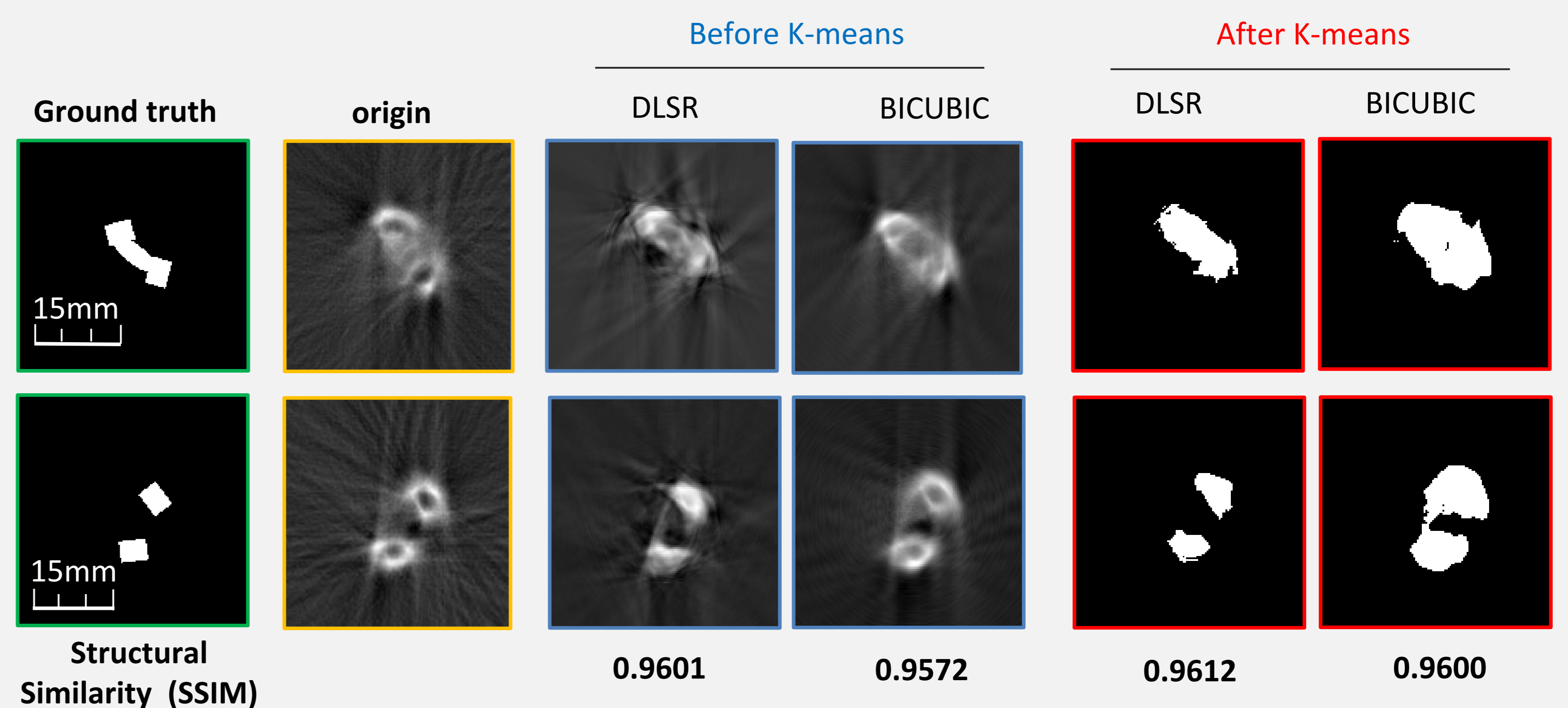


THz CT system[1]



- Number of sampling angle(θ): 30 in 180°
- Number of ray(ρ): 0.25mm per step
- Number of slices: 940
- Acquisition time: 1 sec / angle

Result



- THz deep learning super resolution on sinogram method suppresses the THz images artifact level and give higher contrast resolution.
- This method provides an alternative way to boost the speed of THz CT imaging system while maintain the image quality

[1] Y.-C. Hung and S.-H. Yang, "Terahertz Deep Learning Computed Tomography," in *2019 44th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz)*, 2019: IEEE, pp. 1-2

[2] Z.-H. Tu, Y.-C. Hung, S.-H. Yang, "Terahertz Deep Learning Super Resolution Imaging Training on Sinogram", in *2020, 45th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz)*