Super Resolution Ultrasound via Model Based Deep Learning for Improved Breast Lesion Characterization

Or Bar-Shira¹, Ahuva Grubstein²,³, Yael Rapson²,³, Dror Suhami²,³, Eli Atar²,³, Keren Peri-Hanania¹, Ronnie Rosen¹, and Yonina C. Eldar¹

1. Dept. of Computer Science and Applied Math, The Weizmann Institute of Science, Israel
2. Radiology Department, Beilinson Campus, Rabin Medical Center, Petah Tikva, Israel
3. Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

**Goal:** Reconstruct breast lesion microvasculature via contrast enhanced ultrasound

**Existing methods for microvasculature reconstruction**

**Our approach:**
- Training a model-based deep neural network with architecture inspired from sparse recovery:
  - i. One shot inference
    - Short & known inference time
  - ii. No prior knowledge about the system PSF is required
    - Alleviate dependency on user’s experience

**Problems with sparse recovery approaches:**
- i. Slow inference due to the iterative structure of the algorithms
  - Impairs the translation of super-resolution US into the clinic
- ii. Manual calibration of the system PSF is required
  - High user dependency

We showed super resolved microvasculature recoveries in human patients with various breast lesions. Our results demonstrate different morphological features, which are characteristic of the various lesions, thus assisting diagnosis.