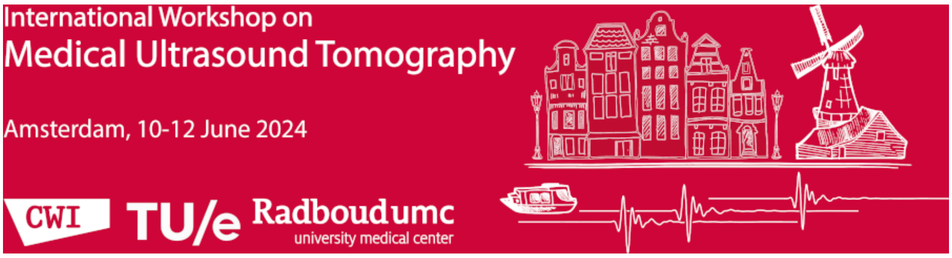

Contribution ID: **37** Type: **not specified**

ASPIRE: Iterative Normalizing Flows for Fast Transcranial Ultrasound with Uncertainty Quantification

Wednesday, June 12, 2024 3:20 PM (20 minutes)

Transcranial ultrasound computed tomography using Full-Waveform Inversion presents a unique challenge due to the non-linear physics and the computational expense of wave physics. We address this challenge with a probabilistic framework that learns to sample the Bayesian posterior of brain parameters that match the data. To scale to realistic parameter sizes, we use normalizing flows and preprocess the raw waveforms with a physics-based summary statistic. In order to mitigate non-convexity, we propose a novel approach that alternates between normalizing flow training and improving the summary statistic using the current estimate from the normalizing flow. We denote our proposed method, **ASPIRE**: Amortized posteriors with Summaries that are Physics-based and Iteratively REfined. Our evaluation shows that our method can accurately image through the skull while maintaining low online costs at four PDE solves, compared to the hundreds of PDE solves used in traditional approaches. To demonstrate the accuracy of our image reconstruction and its uncertainty quantification, we compare our method against a technique from the literature and find that our approach provides more accurate reconstructions, is faster, and offers better-calibrated uncertainty.

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Session Classification: Machine Learning

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