**Faster and Better MRI using Generative AI**

* Motivations
  + MRI is slow
    - Possible solutions
      * Compressed sensing: collect fraction of data
        + Uses alternating minimization approach by alternating between conjugate step and denoiser
      * Recover images using deep learning
        + Fast
        + Needs a lot of training data
  + Motion artifacts/noise during process
* Diffusion Model
  + Train a denoising model by iteratively denoising an image
  + Use a diffusion model and a guidance system
  + Reconstructions was pretty fast
  + Currently under FDA approval
  + What if methods do not have fully sampled data
* Challenges
  + Requires a lot of data and hard to acquire
    - What about applying to different parts of the body
  + Are the models really robust
    - Convergence guarantees
    - Guarantee robustness
* Build Larger and Robust Models
  + Use equilibrium model
    - Unique fixed point iff some condition is satisfied
    - Way to measure robustness to perturbation
  + Constrain operator to be monotone
    - Assumption: data lies on a low-dimensional manifold
      * Operator is monotone in a certain ball => relaxes monotonicity performance
      * Successful
      * Still not perfect
* Unrolling
  + Adding noise => unrolling makes it more robust
    - Unrolling improves quality but not universal
* Proposal
  + Join pretrained model with another model
  + Pre-learn energy model for image recovery
  + Train combination of energy model
  + One algorithm that has multiple energy steps even though it has one energy function and trained it on multiple noise levels
* Extensions/Applications
  + Segmentation
  + Motion compensation
  + Silence
  + Cardiac mri
  + Pseudo-3D speech MRI