Research Statement

Yi Li

As a graduate student in Computer Science at Northwestern University, I am postively seeking a research opportunity to further delve into the fields of computer vision, machine learning, and 3D graphics. My research interests primarily lie in unsupervised learning, 3D computer vision, and the application of deep learning in image and video processing.

Research Experience and Contributions

During undergraduate studies at CUHKSZ, I served as an Undergraduate Researcher in the Generation and Analysis of Pixels, Points, and Polygons (GAP) Lab. Contributions were made to projects on 3D cartoon face reconstruction and multi-style 3D face reconstruction, employing advanced 3D techniques such as 3D Morphable Models (3DMM), UV maps, generative adversarial networks, and differentiable renderers to achieve state-of-the-art results in 2D landmark and color difference metrics. Efforts culminated in a paper submitted to the IEEE Transactions on Visualization and Computer Graphics (TVCG), where I served as the secondary author. Significant contributions were made to the algorithm and experiments design for 3D reconstruction, with independent implementation of the majority of the reconstruction algorithm, demonstrating practical abilities in the field.

Currently, as a Graduate Researcher in the Image & Video Processing Lab (IVPL) at Northwestern University, I am leading a project focused on the unsupervised clustering of gravitational wave glitches captured by The Laser Interferometer Gravitational-Wave Observatory (LIGO). The project involves developing a novel four-branch autoencoder that integrates Convolutional Neural Networks (CNN) and Vision Transformers (ViT) to extract both global and local features from glitches across different time window durations. The aim is to advance the understanding of gravitational waves and contribute to the field of astrophysics. The role as the first author on a paper accepted by the IEEE/CVF Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPRW) underscores the capacity to manage and execute the entire project successfully.

Future Research Goals

Looking ahead, I am eager to continue my exploration of unsupervised learning techniques for image and video analysis, with a focus on developing algorithms that can effectively leverage the vast amounts of unlabeled data available in these domains. I am also interested in furthering my work in 3D computer vision, particularly in the areas of 3D reconstruction and 3D object recognition.

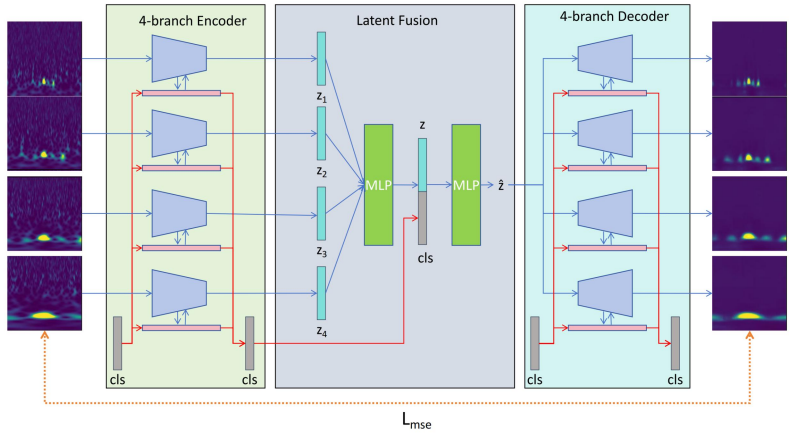
Conclusion

My research journey so far has been a blend of exploration, learning, and innovation. With a strong foundation in computer science, a passion for computer vision and machine learning, and a commitment to excellence, I am eager to continue contributing to the field through research and collaborations.

**As a graduate student at Northwestern University, I am seeking a summer research opportunity in the fields of computer vision, machine learning, and 3D graphics. **

Unsupervised LIGO Gravitational Wave Glitches Clustering, 11/2023-present

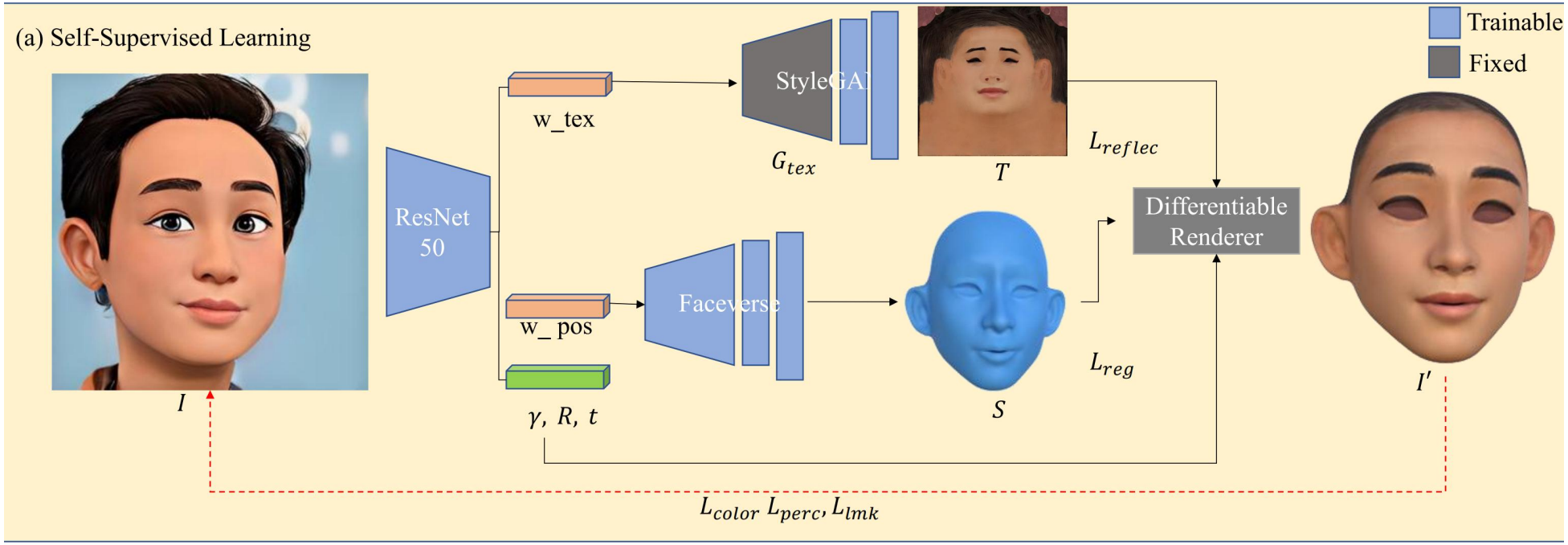
- Objective: developed unsupervised algorithms for clustering gravitational wave glitches captured by The Laser Interferometer Gravitational-Wave Observatory (LIGO)



- **Publication**: **Yi Li**, Yunan Wu, and Aggelos K. Katsaggelos. *Cross-Temporal Spectrogram Autoencoder (CTSAE): Unsupervised Dimensionality Reduction for Clustering Gravitational Wave Glitches*. Accepted by IEEE/CVF Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)
- Approach:
  - Built a novel four-branch autoencoder which integrated CNN and ViT to extract global and local features from glitches across four different time window durations
  - Designed a novel CLS fusion module for effective inter-branch communication
- Contributions
  - Leaded the unsupervised Gravitational Wave Glitches Clustering project
  - As the first author, composed the whole conference paper
  - Independent implementation, maintenance and improvement of the algorithms

Multi-style 3D Face Stylization, 05/2023-09/2023

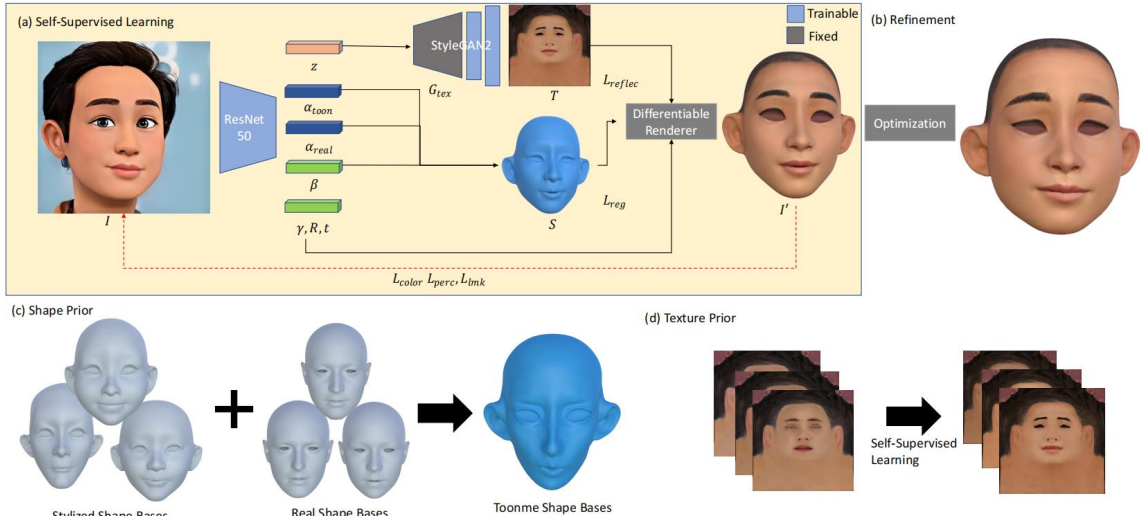
- Objective: achieved style transfer in 3D space, transferring a real 3D face into various styles.



- Approach:
  - Representation: UV maps for both shape and texture
  - Use a conditional StyleGAN for shape reconstruction and a standard StyleGAN for texture synthesis
  - Generate 3D heads in the styles of real, cartoon, and caricature using a single pipeline
- Contributions
  - Independent design and improvement of the pipeline
  - Independent implementation and maintenance of the majority of the reconstruction algorithm

3D Cartoon Face Reconstruction, 05/2022-05/2023

- Objective: given a 2D real face image, first generated the 2D cartoon face using neural style transfer (NST). Reconstructed the 3D cartoon from the stylized image.



- **Publication**: Yuda Qiu, **Yi Li**, Xiao Zitong, Xianggang Yu, Yushuang Wu, and Xiaoguang Han. *Toonme3D: Stylizing 3D Face by Reconstruction from Stylized Images.* Submitted to IEEE Transactions on Visualization and Computer Graphics(TVCG)
- Approach: Two-stage reconstruction pipeline
  - Representation: 3D morphable model(3DMM) with novel cartoon bases for shape, UV maps and StyleGAN for texture.
  - Coarse stage: a ResNet is used to predict the 3DMM coefficients(shape), StyleGAN latent code(texture), camera pose and illumination coefficient for rendering.
  - Refine stage: using the output from the coarse stage as an initialization, refine the shape and texture by optimization
- Contributions
  - Algorithms and experiments design for 3D reconstruction
  - Independent implementation and maintenance of the majority of the reconstruction algorithm
  - Writed the experiment part of the journal paper