Q1:LSTM

Table 1 LSTM Model Details

Number of Layers	2
Hidden Layer Size	128
Learning Rate	0.001
Dropout	0.1
Optimizer	Adam
Loss	Mean Square Error
Test L1 error	1.0666
Test L2 error	0.0040

Visualization of Training Loss Vs Epoch

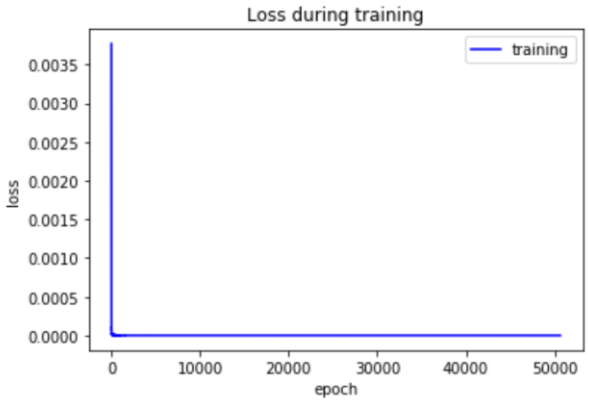

Figure 1 LSTM Training versus Epoch

Visualization of Prediction of Flow velocity comparing to the ground truth

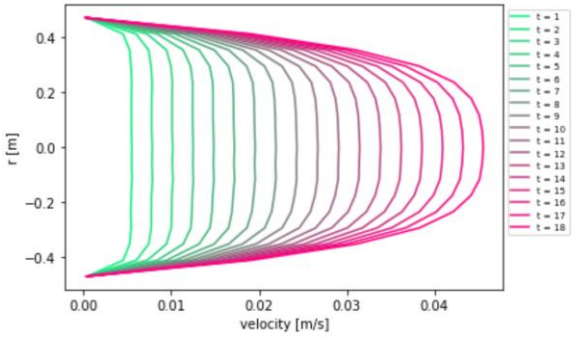

Figure 2 Prediction Using LSTM

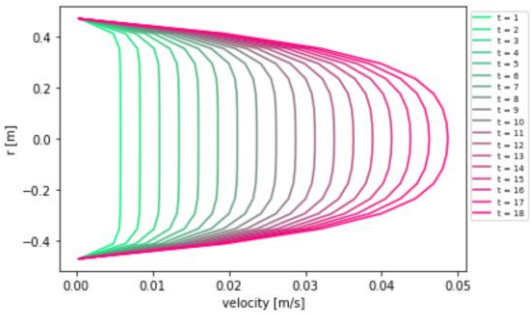

Figure 3 Ground Truth

Q2 Part 1-VAE

Table 2 VAE Model Details

Number of Layers	2
Hidden Layer Size	512
Learning Rate	0.001
Optimizer	Adam
Loss	Reconstruction Loss and KL Divergence

Visualization of Training Versus Epoch

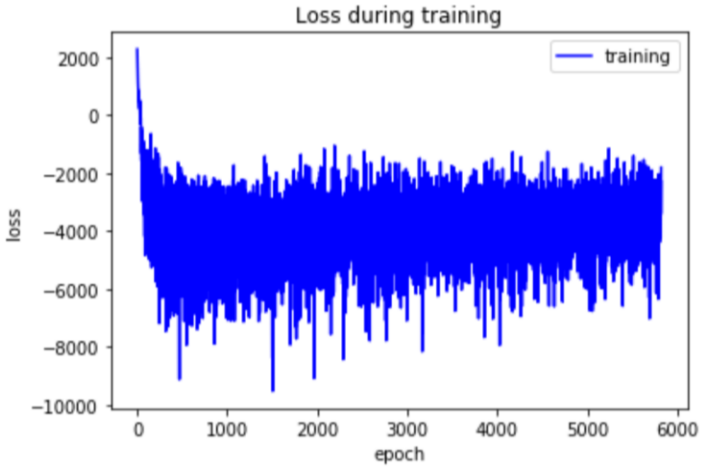

Figure 4 VAE Training Versus Epoch

Visualization of airfoils

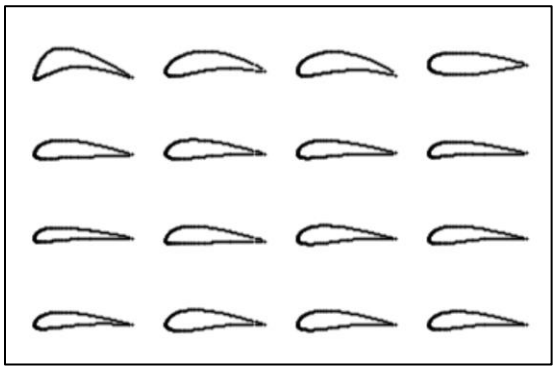

Figure 5 Real Airfoils

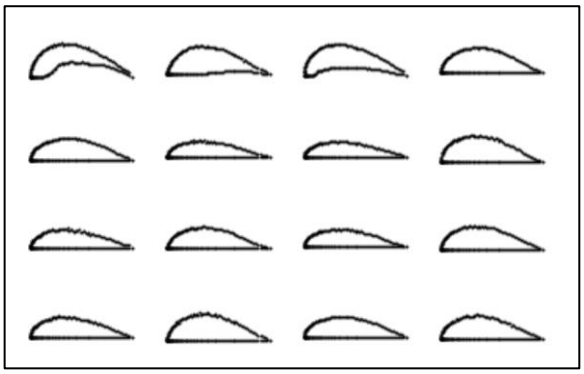

Figure 6 Reconstructed Airfoils

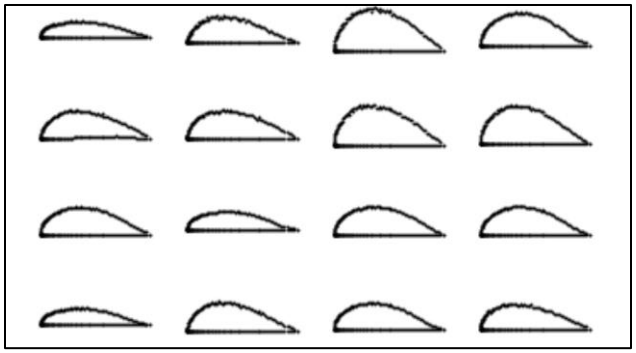

Figure 7 Synthesized Airfoils VAE

Q2 Part 2- GAN

Table 3 GAN Model Details

Number of Layers-Generator	3
Number of Layers-Discriminator	5
Hidden Layer Sizes-Generator	512,256
Hidden Layer Sizes-Discriminator	128,256,512 and 1024
Learning Rate-Generator	0.0005
Learning Rate-Discriminator	0.0005
Activation Functions-Generator	Tanh
Activation Functions-Discriminator	Leaky ReLU, Leaky ReLU, Sigmoid
Optimizer for Gen and Dis	Adam
Loss for Gen and Dis	Binary Cross Entropy

Visualization of Training Versus Epoch

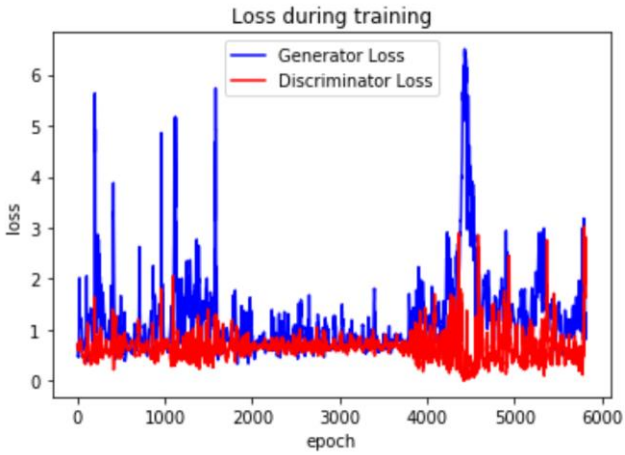

Figure 8 GAN Training Loss

Visualization of airfoils

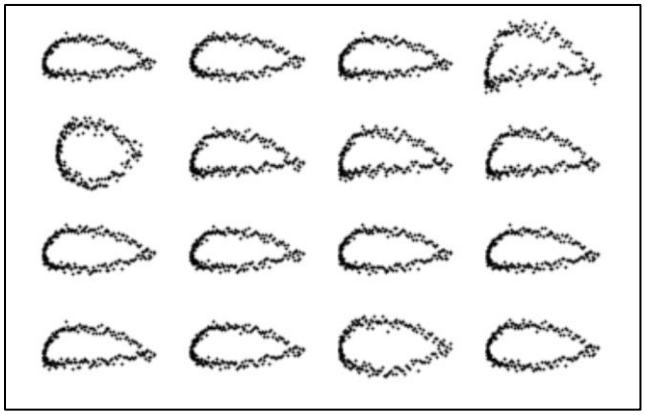

Figure 9 Synthesized Airfoils GAN

Comparison of synthesized airfoils of VAE and GAN

1) It can be seen that the airfoils of GAN is more noisy than VAE
2) It is due to the fact that in GAN is hard to train as it has two models (generator and discriminator) which are to be trained simultaneously that can lead to convergence issues due to which the output is noisy and does not conserve important continuity properties important for aerodynamic shapes.
3) Performance of GAN can be improved by adding instance noise to remedy the poor convergence properties of GAN