Video Prediction on Moving MNIST

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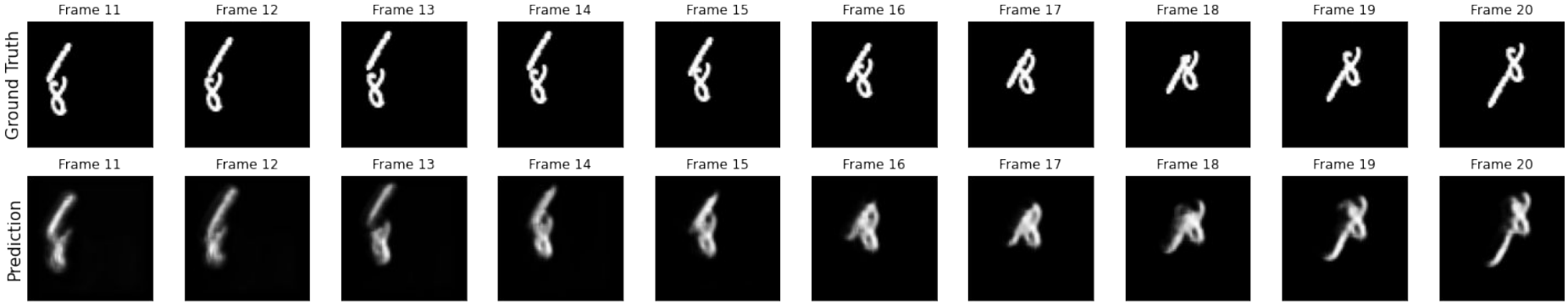
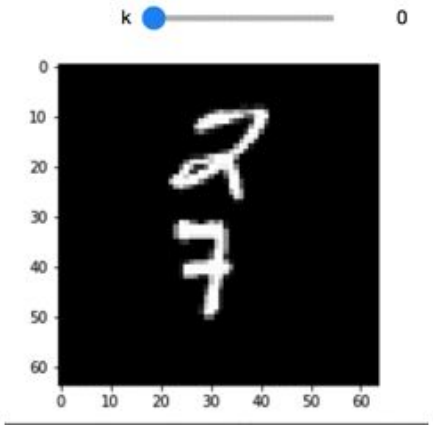
Video Prediction task

Video Prediction is the task of predicting **future frames** given past video frames.



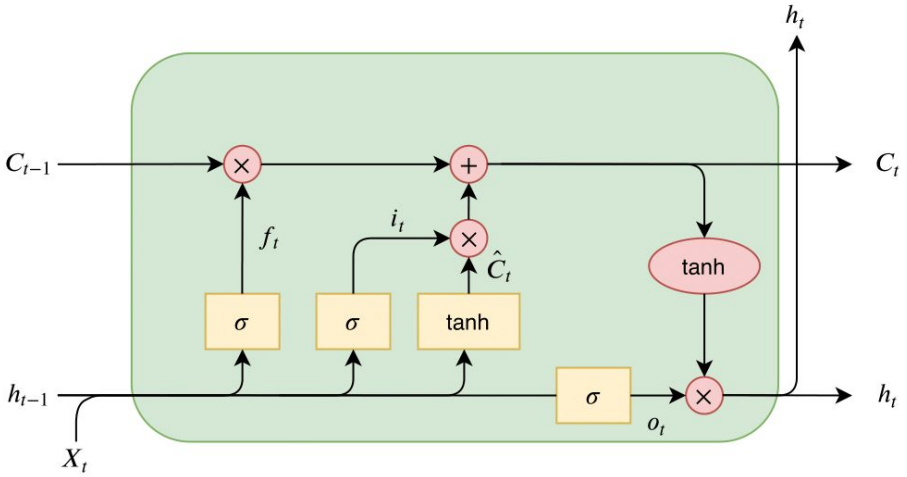
Moving MNIST

Moving MNIST is a synthetic dataset consisting of videos of two digits independently moving within the 64×64 grid and bouncing off the boundary.



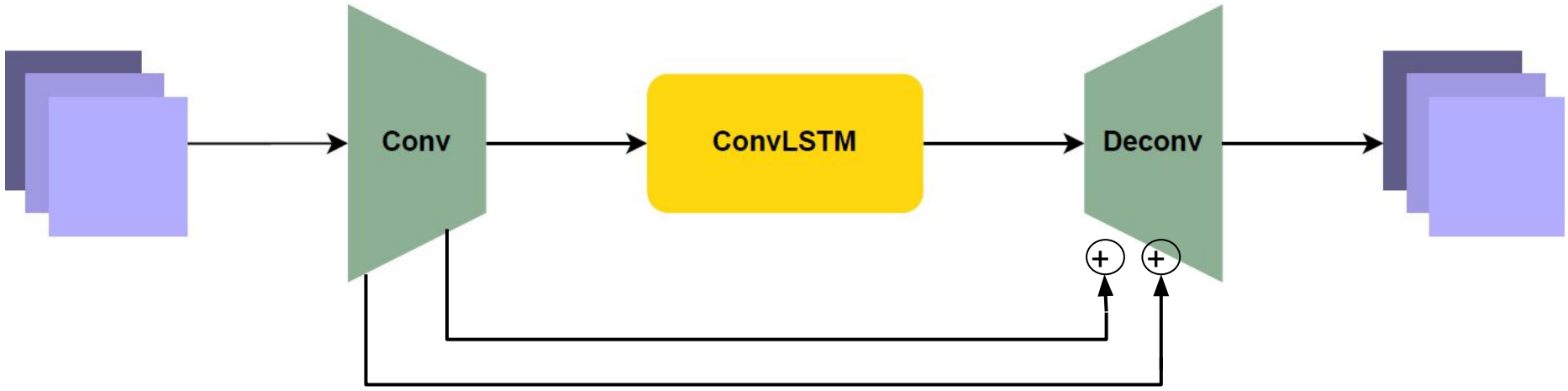
Moving MNIST videos are **20 frames** long. The first 10 are given as input, and the other 10 are used as ground truth for computing **MSE**

SimpleLSTM



- **f** Forget gate
- **i** Input gate
- **o** Output gate

ConvLSTM



$$i_t = \sigma(W_{xi} * X_t + W_{hi} * H_{t-1} + W_{ci} \odot \mathcal{C}_{t-1} + b_i)$$

$$f_t = \sigma(W_{xf} * X_t + W_{hf} * H_{t-1} + W_{cf} \odot \mathcal{C}_{t-1} + b_f)$$

$$\mathcal{C}_t = f_t \odot \mathcal{C}_{t-1} + i_t \odot \tanh(W_{xc} * X_t + W_{hc} * \mathcal{H}_{t-1} + b_c)$$

$$o_t = \sigma(W_{xo} * X_t + W_{ho} * \mathcal{H}_{t-1} + W_{co} \odot \mathcal{C}_t + b_o)$$

$$\mathcal{H}_t = o_t \odot \tanh(C_t)$$

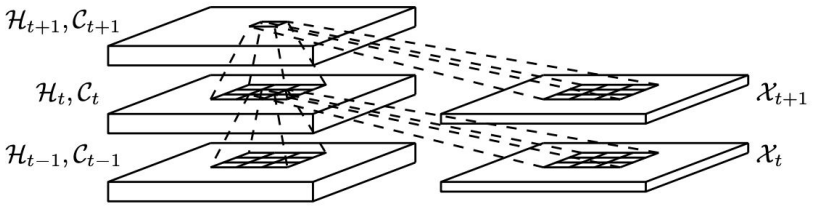
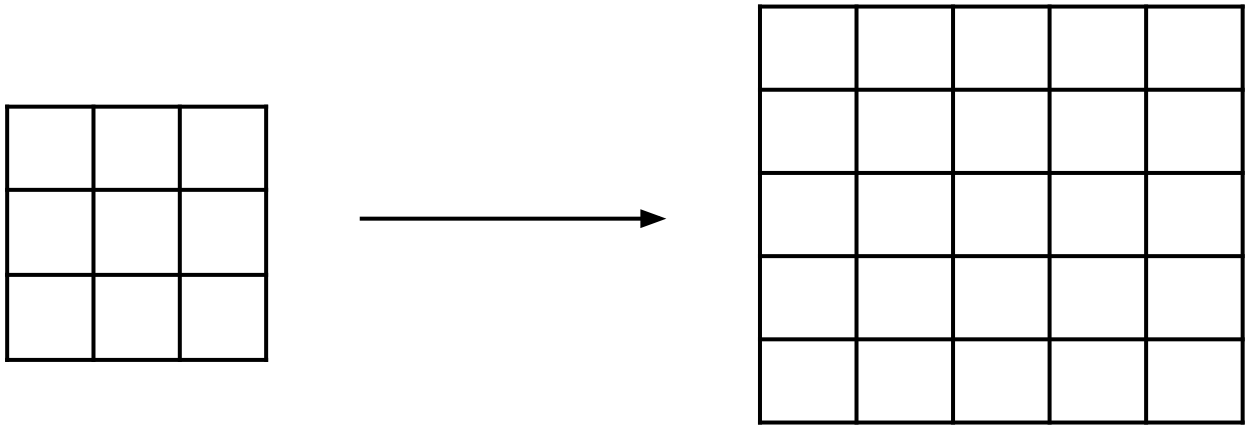


Figure 2: Inner structure of ConvLSTM

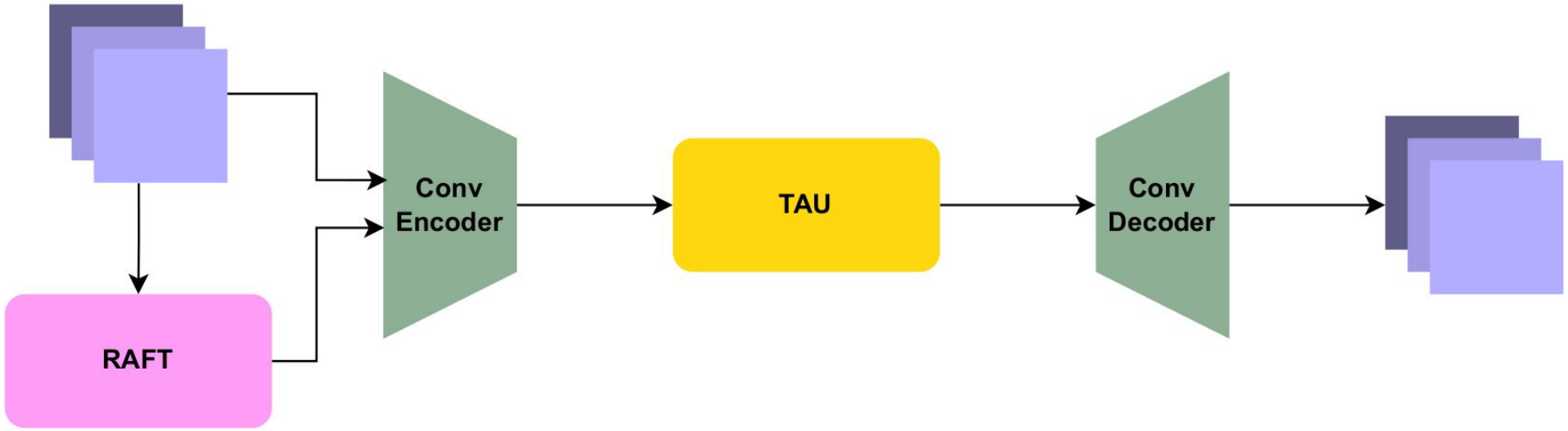
We tried different combinations of hyperparameters while varying:

- Activation functions
- Optimizers
- Number of features
- Number of layers

The major improvement was obtained by improving the **kernel size**



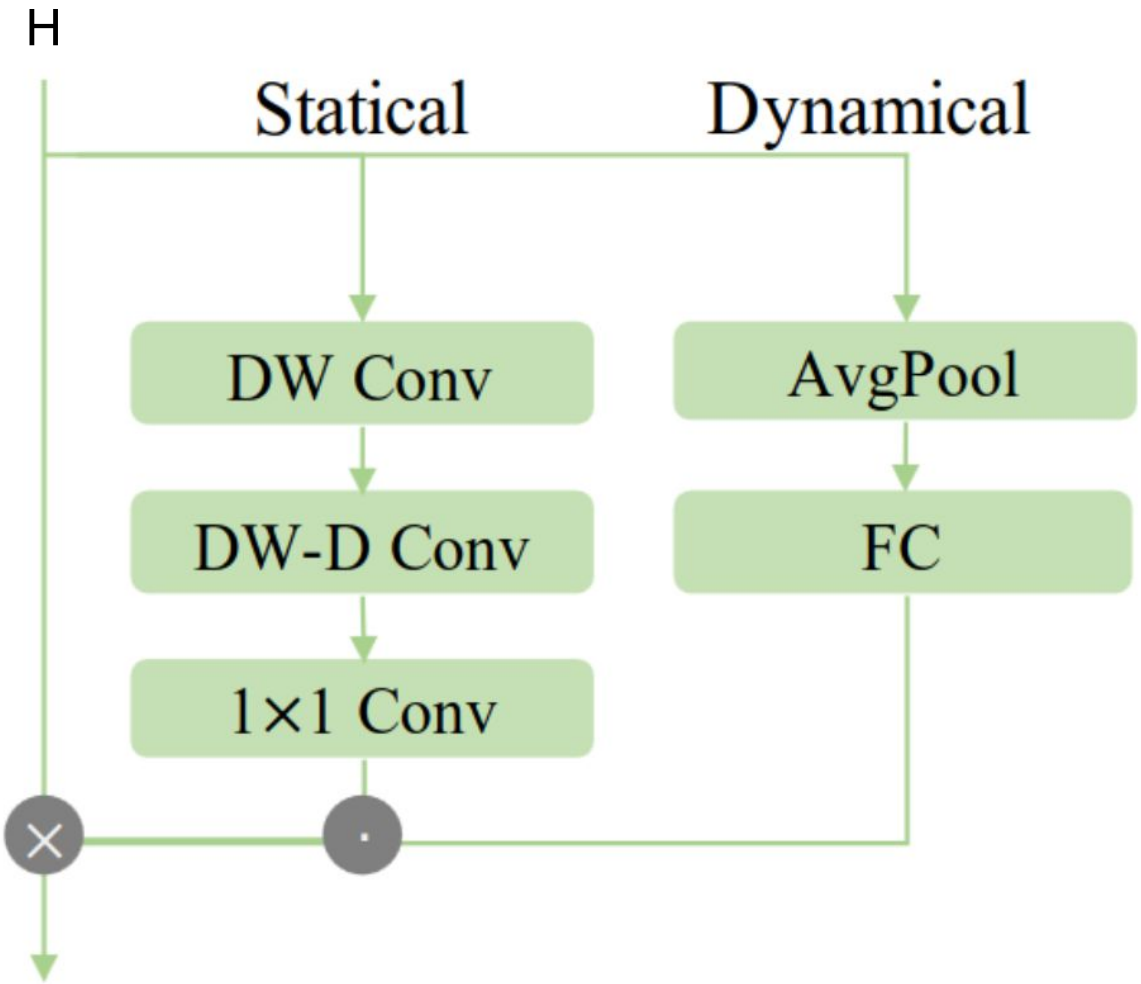
ConvTAU



Key components:

- Convolutional Encoder / Decoder
- Temporal Attention Unit
- RAFT - Optical Flow Estimator

Temporal Attention Unit



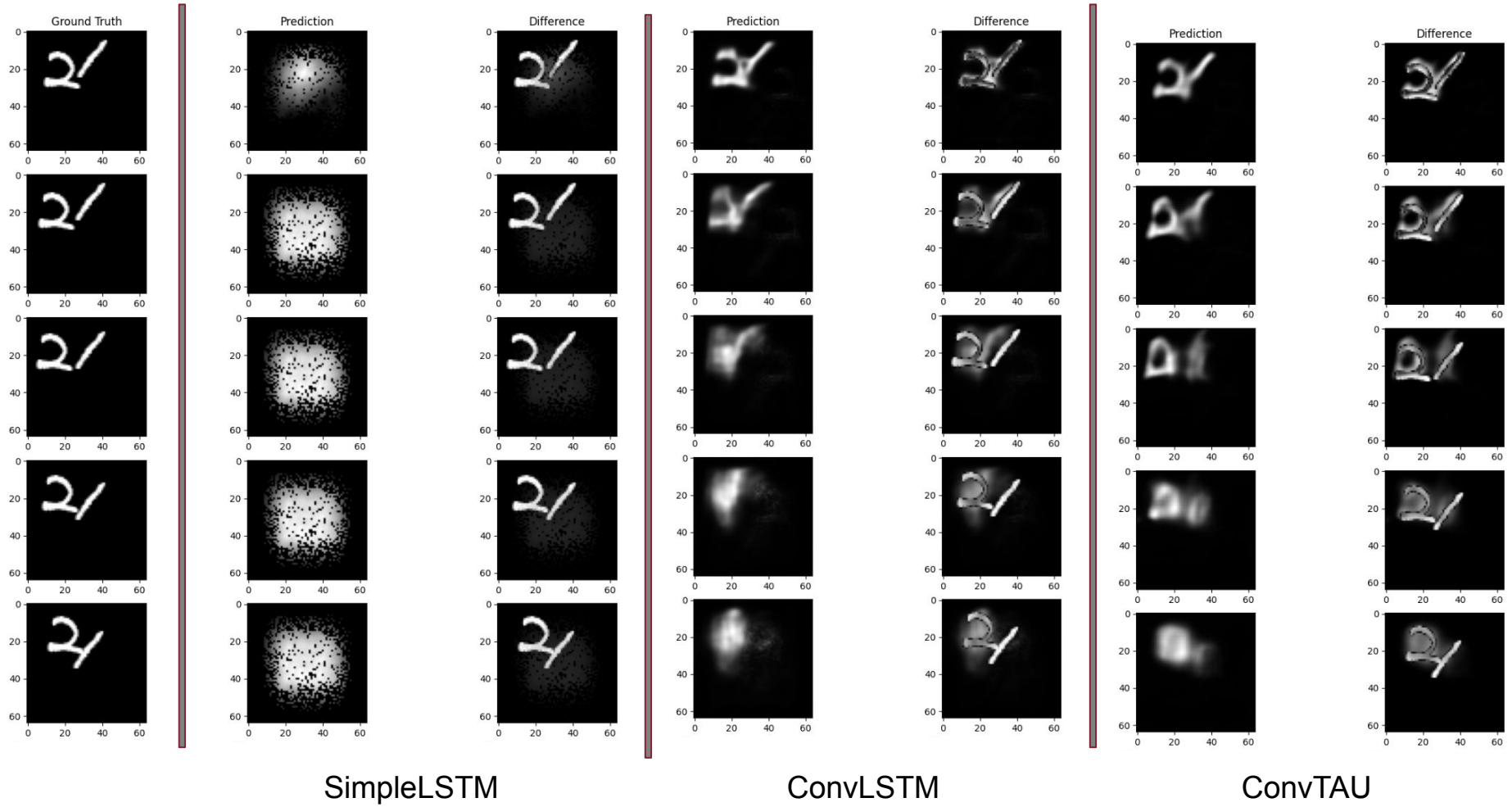
Results

Model	MSE
SimpleLSTM	2478
ConvLSTM	1927
ConvTAU (original)	1647
ConvTAU (ours)	**1520**

Results

Training loss of ConvLSTM with 5x5 and 3x3 kernels.

Results



SimpleLSTM ConvLSTM ConvTAU

Conclusions

MSE scores far from those of S.O.T.A. models

Possible improvements:

- Stronger KL divergence term in the Loss
- Teacher forcing (for ConvLSTM)
- Weights initialization

Thanks for your Attention!

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