

Supplementary Materials

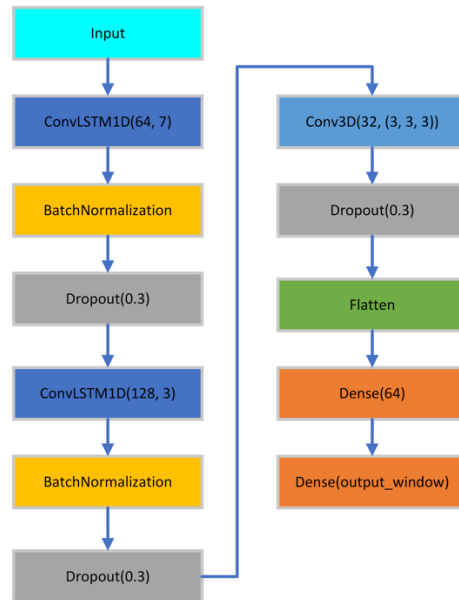


Figure 1. Brief model architecture based on ConvLSTM1D

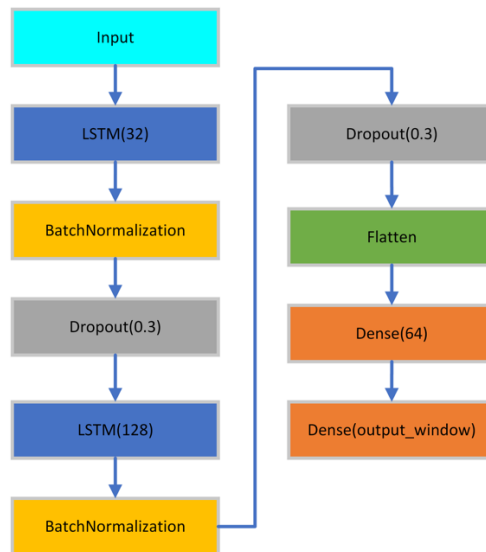


Figure 2. Brief model architecture based on LSTM

Table 1. Preprocessed dataset in slicing window fashion for Deep Learning method

Input window	Output window	Input segment shape		Output segment shape		Total data points of input	Total data points of output	X_train	X_test	y_train	y_test
7	1	3,006	7	3,006	1	21,042	3,006	16,834	4,208	2,405	601
7	3	3,004	7	3,004	3	21,028	9,012	16,822	4,206	7,210	1,802
7	7	3,000	7	3,000	7	21,000	21,000	16,800	4,200	16,800	4,200
8	2	3,004	8	3,004	2	24,032	6,008	19,226	4,806	4,806	1,202
15	5	2,994	¹ 5	2,994	5	44,910	14,970	35,928	8,982	11,976	2,994

Table 2. Preprocessed dataset in slicing window fashion for Machine Learning method

Input window	Output window	Input segment shape		Output segment shape		Total data points of input	Total data points of output	X_train	X_test	y_train	y_test
3	3	3,008	3	3,008	3	9,024	9,024	7,219	1,805	7,219	1,805
5	5	3,004	5	3,004	5	15,020	15,020	12,016	3,004	12,016	3,004
7	7	3,000	7	3,000	7	21,000	21,000	16,800	4,200	16,800	4,200
9	9	2,996	9	2,996	9	26,964	26,964	21,571	5,393	21,571	5,393
15	15	2,984	¹ 5	2,984	15	44,760	44,760	35,808	8,952	35,808	8,952

Table 3. ConvLSTM1D model configurations

Layer Type	Filters	Kernel Size	Padding	Activation	Additional Info
ConvLSTM1D	64	7	same	swish	-
BatchNormalization (axis=3)	-	-	-	-	Applied after ConvLSTM1D
Dropout (0.3)	-	-	-	-	-
ConvLSTM1D	128	3	same	swish	-
BatchNormalization (axis=3)	-	-	-	-	Applied after second ConvLSTM1D
Dropout (0.3)	-	-	-	-	-
Reshape	-	-	-	-	Reshaping for Conv3D compatibility
Conv3D	32	3, 3, 3	same	swish	-
Dropout (0.3)	-	-	-	-	-
Flatten	-	-	-	-	Flattens the output for Dense layer
Dense	64	-	-	swish	Intermediate Dense layer
Dense	num classes	-	-	linear	

Table 4. LSTM model configurations

Layer Type	Units	Return Sequences	Activation
LSTM	32	TRUE	swish
BatchNormalization	-	-	-
Dropout (0.3)	-	-	-
LSTM	64	TRUE	swish
BatchNormalization	-	-	-
Dropout (0.3)	-	-	-
LSTM	128	FALSE	swish
BatchNormalization	-	-	-
Dropout (0.3)	-	-	-
Flatten	-	-	-

Dense	64	-	swish
Dense	num_classes	-	linear

Table 5. ConvLSTM1D -BiLSTM model configurations

Layer Type	Filters	Kernel Size	Padding	Activation	Additional Info
ConvLSTM1D	64	7	same	swish	-
BatchNormalization (axis=3)	-	-	-	-	-
Dropout (0.3)	-	-	-	-	-
ConvLSTM1D	128	3	same	swish	-
BatchNormalization (axis=3)	-	-	-	-	-
Dropout (0.3)	-	-	-	-	-
Reshape	-	-	-	-	Reshaping for Conv3D compatibility
Conv3D	32	3, 3, 3	same	swish	-
Dropout (0.3)	-	-	-	-	-
TimeDistributed(Flatten)	-	-	-	-	Applies Flatten over time dimension
Bidirectional LSTM (64)	-	-	-	-	-
Dense	num_classes	-	-	linear	

Table 6. Hyperparameter configurations for all Deep Learning models

Parameter	Value	Description
Initial Learning Rate (init_lr)	0.0001	Initial learning rate for the optimizer
Epochs	50	Number of epochs for training
Batch Size	2	Size of the batches used in training
Optimizer	Adam	Type of optimizer used
Learning Rate	0.0001	Learning rate used in Adam optimizer
Loss Function	Mean Squared Error (mse)	Loss function used for training
Metrics	Mean Absolute Error (mae), Mean Squared Error (mse)	Performance metrics used during training
Validation Split	30% (0.3)	Proportion of the dataset used for validation

Table 7. Slicing configurations for tuning the ConvLSTM1D-BiLSTM model

W_in	W_out	stride	X.shape	y.shape	X_train	X_test	y_train	y_test
7	1	1	(3006, 7)	(3006, 1)	(2404, 7)	(602, 7)	(2404, 1)	(602, 1)
7	1	2	(1503, 7)	(1503, 1)	(1202, 7)	(301, 7)	(1202, 1)	(301, 1)
7	1	3	(1002, 7)	(1002, 1)	(801, 7)	(201, 7)	(801, 1)	(201, 1)
7	1	4	(752, 7)	(752, 1)	(601, 7)	(157, 7)	(601, 1)	(157, 1)
7	1	5	(602, 7)	(602, 1)	(481, 7)	(121, 7)	(481, 1)	(121, 1)
7	1	6	(501, 7)	(501, 1)	(400, 7)	(101, 7)	(400, 1)	(101, 1)
7	1	7	(430, 7)	(430, 1)	(344, 7)	(86, 7)	(344, 1)	(86, 1)