Change Detection

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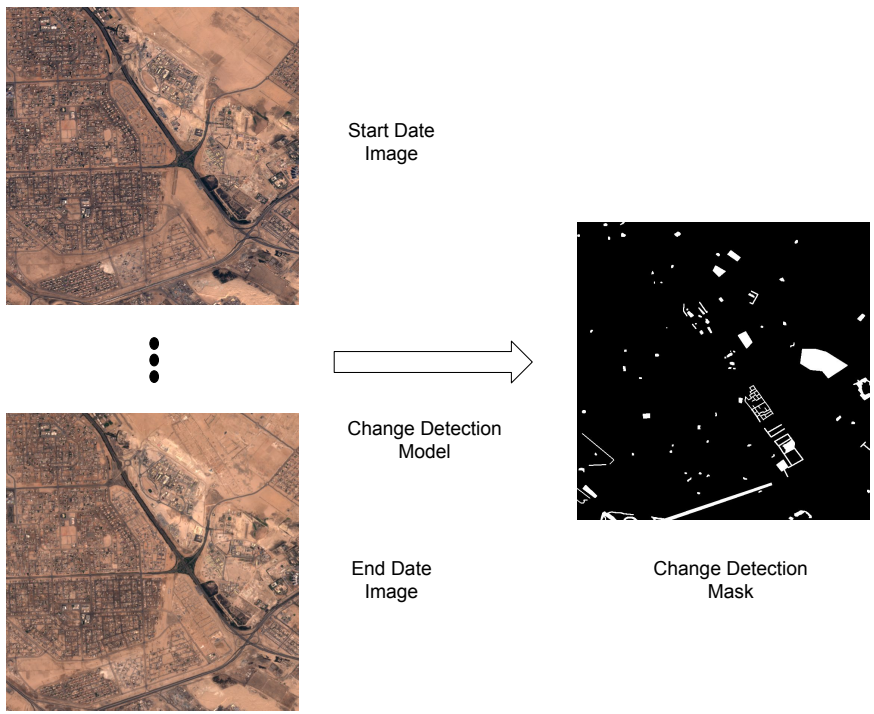
Table Of Contents

Problem Statement

1. Detect pixel wise change.
2. Input: Multiple dates' images of same location.
3. Output: Change mask between start and end dates.



Problem Statement

Challenges

1. How to handle multiple dates as input?
2. Unsupervised model, if data scarcity?
3. Supervised model, if data abundance?
4. Evaluation criteria for change.

Background

1. Recurrent Neural Networks
2. Long-Short Term Memory
3. 3D Convolution

Background

Recurrent Neural Networks

1. Perform same task for every element of a sequence.
2. Output depends on previous elements.
3. RNNs can be seen as a neural network having "memory".

$$h_t = tanh(Wx_t + Uh_{t-1}), \tag{1}$$

where W and U are weights, h is the hidden vector and x_t is the input at time t.

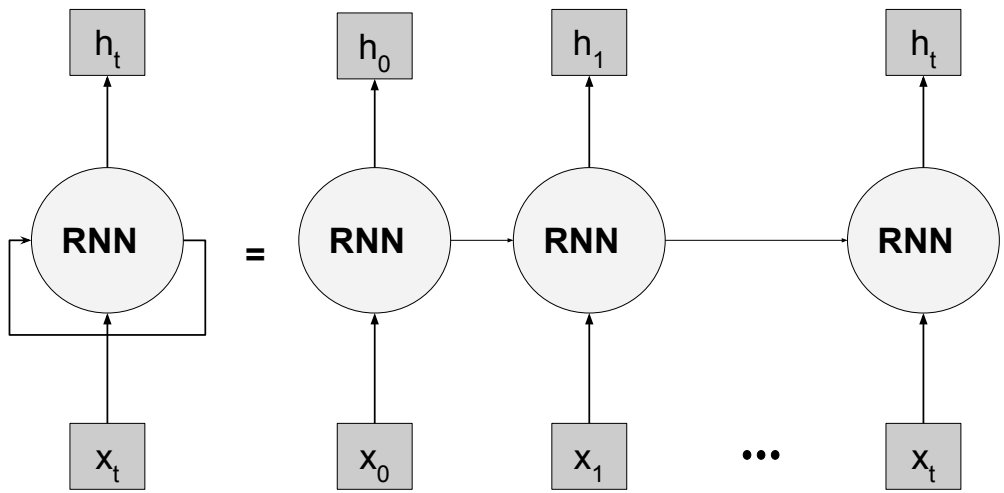


Figure: RNN unrolled in time.

Background

Sequential Networks: Long-Short Term Memory

1. RNNs have vanishing and exploding gradients problem.
2. LSTM resolves above problems.
3. Computes when to forget and when to remember.

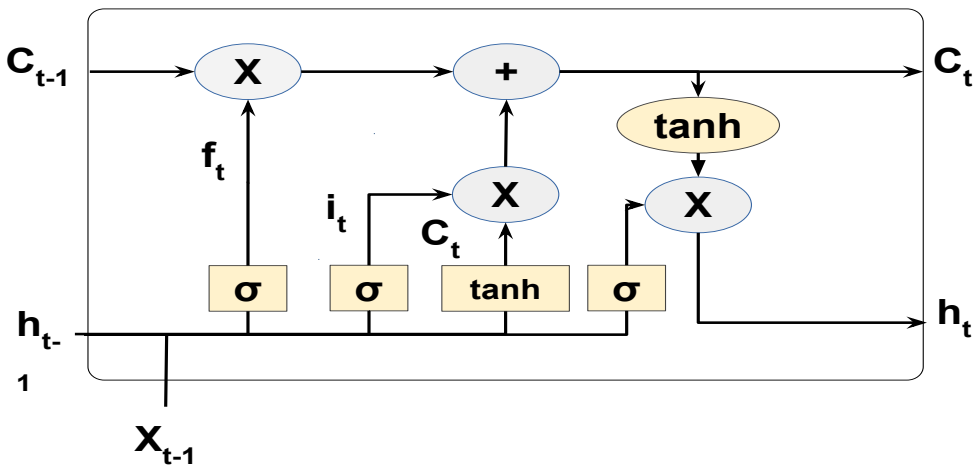


Figure: LSTM Cell.

3D Convolution

1. 4D data, height, width, time/depth, and channel
2. 3D kernel, 3D convolve operation
3. Convolve along height, width and time/depth
4. Used in video tasks and 3d medical images

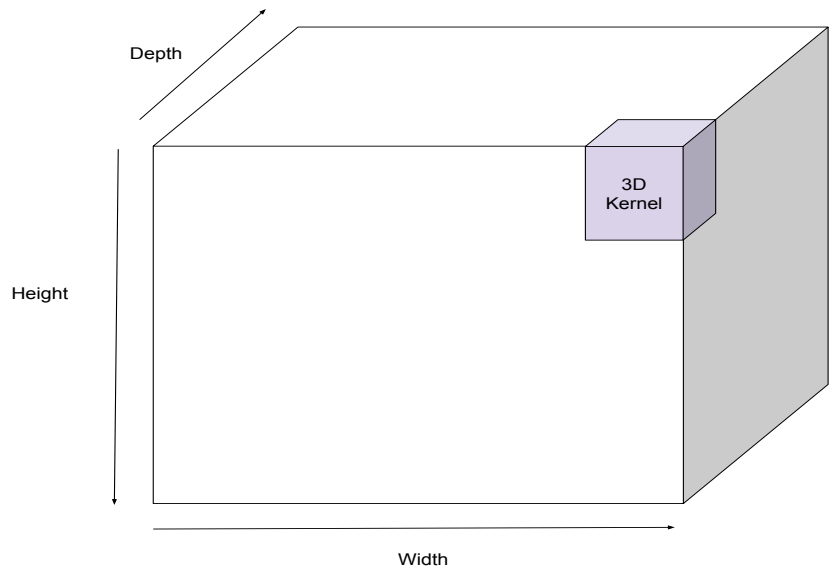


Figure: LSTM Cell.

Dataset and Experiments

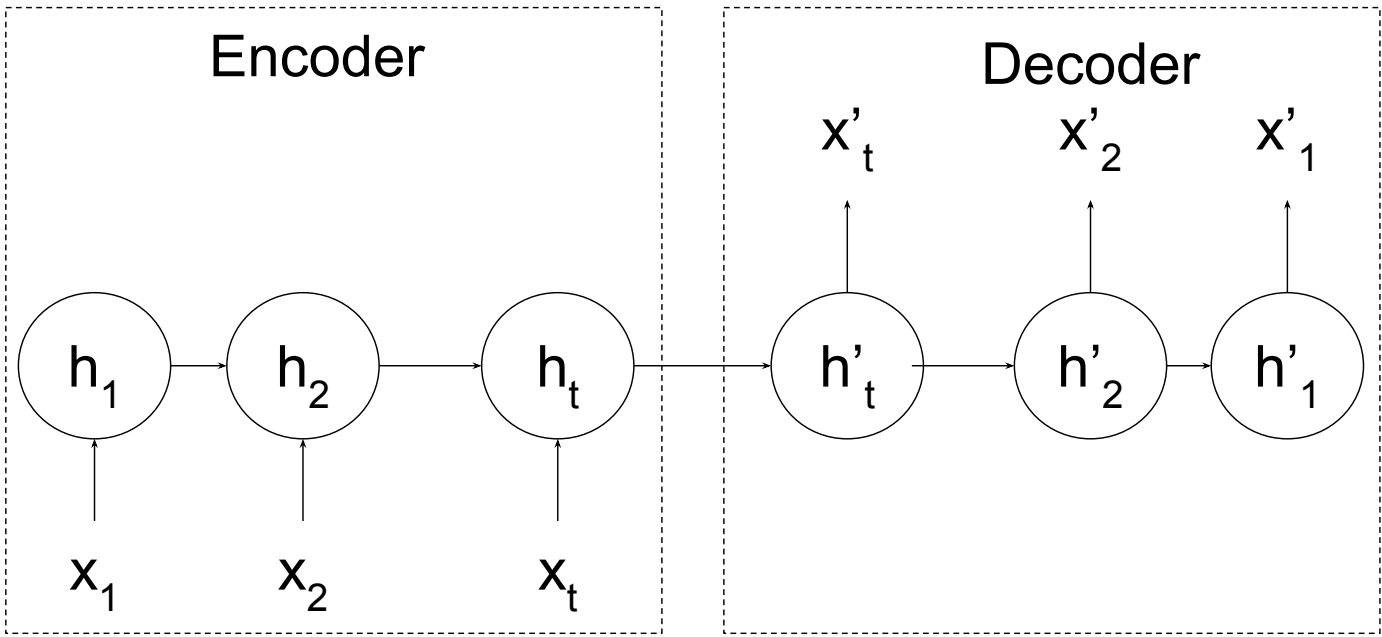
Dataset

1. *ONERA* dataset.
2. 24 locations through out world.
3. Image pairs, two dates.
4. 14 location for training, 10 for testing.
5. 13 bands, sentinel data.
6. Change mask, but everything reprojected.

Dataset and Experiments

Unsupervised Change Detection

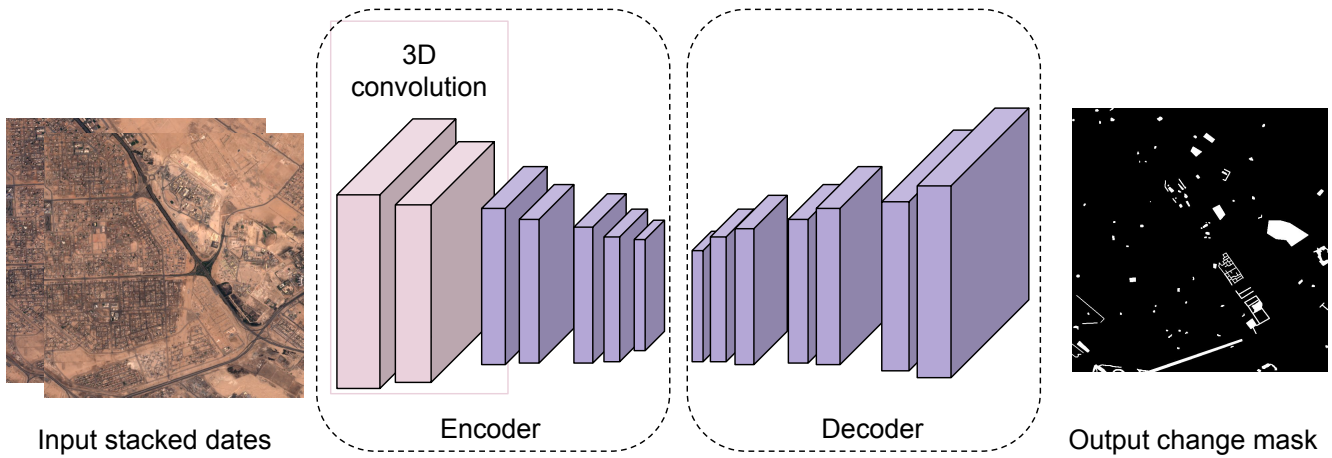
1. Multiple dates, single pixel as input.
2. Try to reconstruct the input.
3. If change occurs reconstruction error is high.



Dataset and Experiments

Supervised Change Detection: 3D CNN

1. Use labeled data, change mask.
2. Stack multiple dates as input.
3. Apply 3D convolution, then 2d convolution.
4. SegNet like architecture.



Results and Conclusions

Model Convergence

Results and Conclusions

Example Outputs

Results and Conclusions

Thank you!
Questions?