Human Intention Prediction Using BIL-SCNN

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Active Vision and perception in Human(-Robot) Collaboration (AVHRC 2020)

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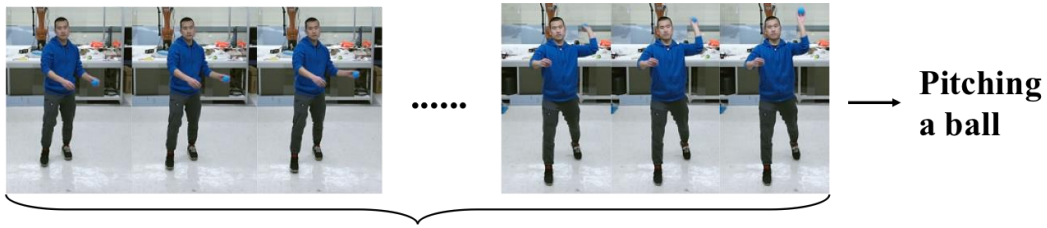
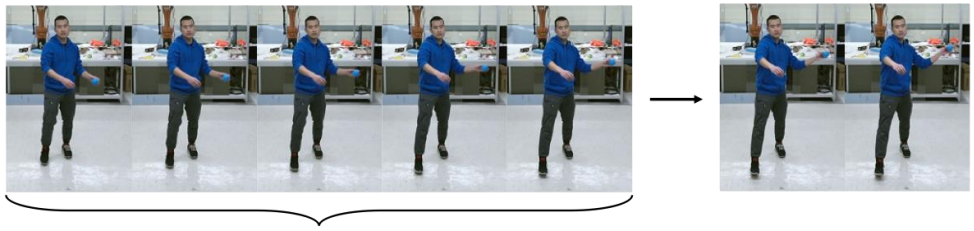
PROBLEM STATEMENT

SUMMARY

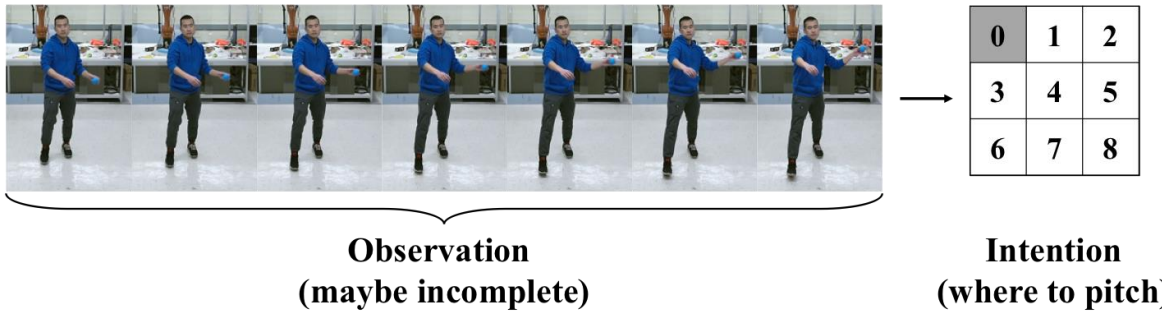
Action Recognition



Action Prediction



Intention Prediction



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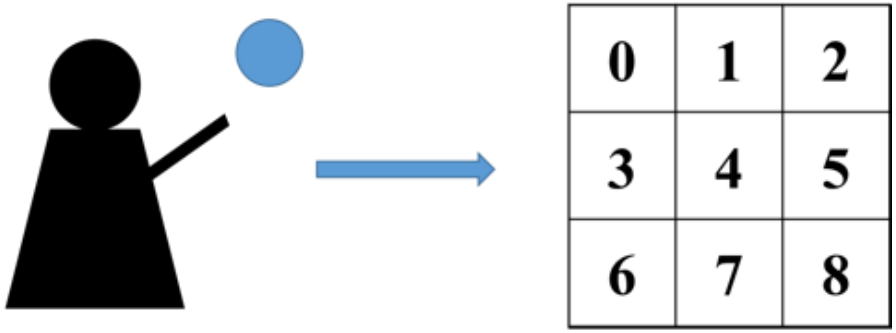
PROBLEM STATEMENT

DATASET



Ball pitching

9 blocks

- **Pitch to 9 target blocks in 3x3**
- **Record actions that pitch the ball to the intended block.**

- **Connect the action outcome with the intention**
- **Label the action with the intention**

Predict the intention with the method of action recognition (A simplified problem)

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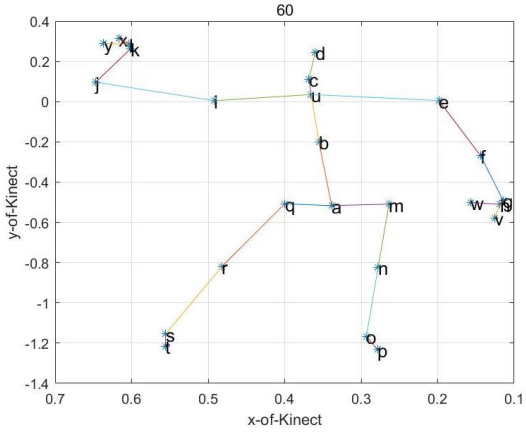
PROBLEM STATEMENT

DATASET

Kinect V2

- RGB images
- Depth images
- Joint positions

Input &
Starting frame



Starting frame

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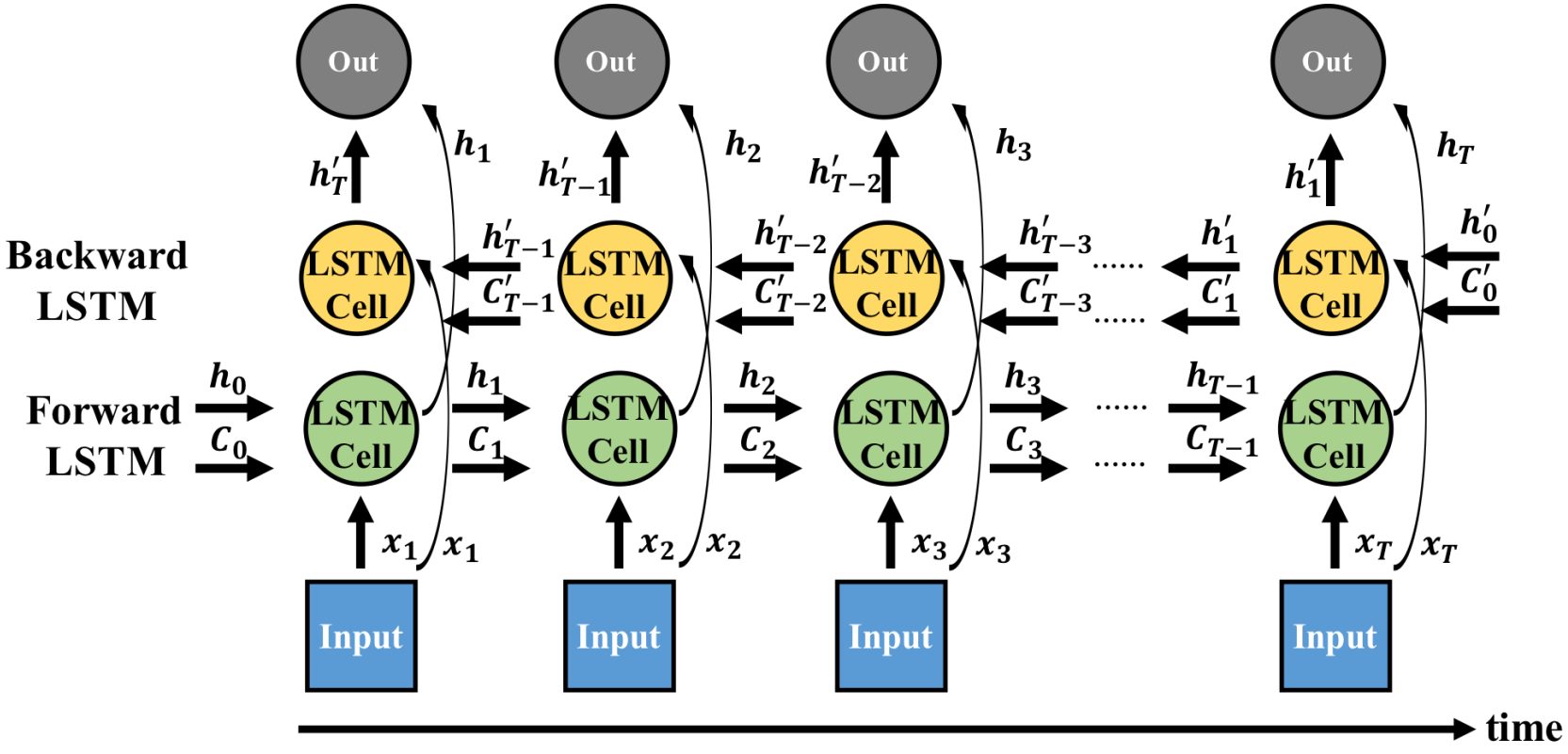
METHOD

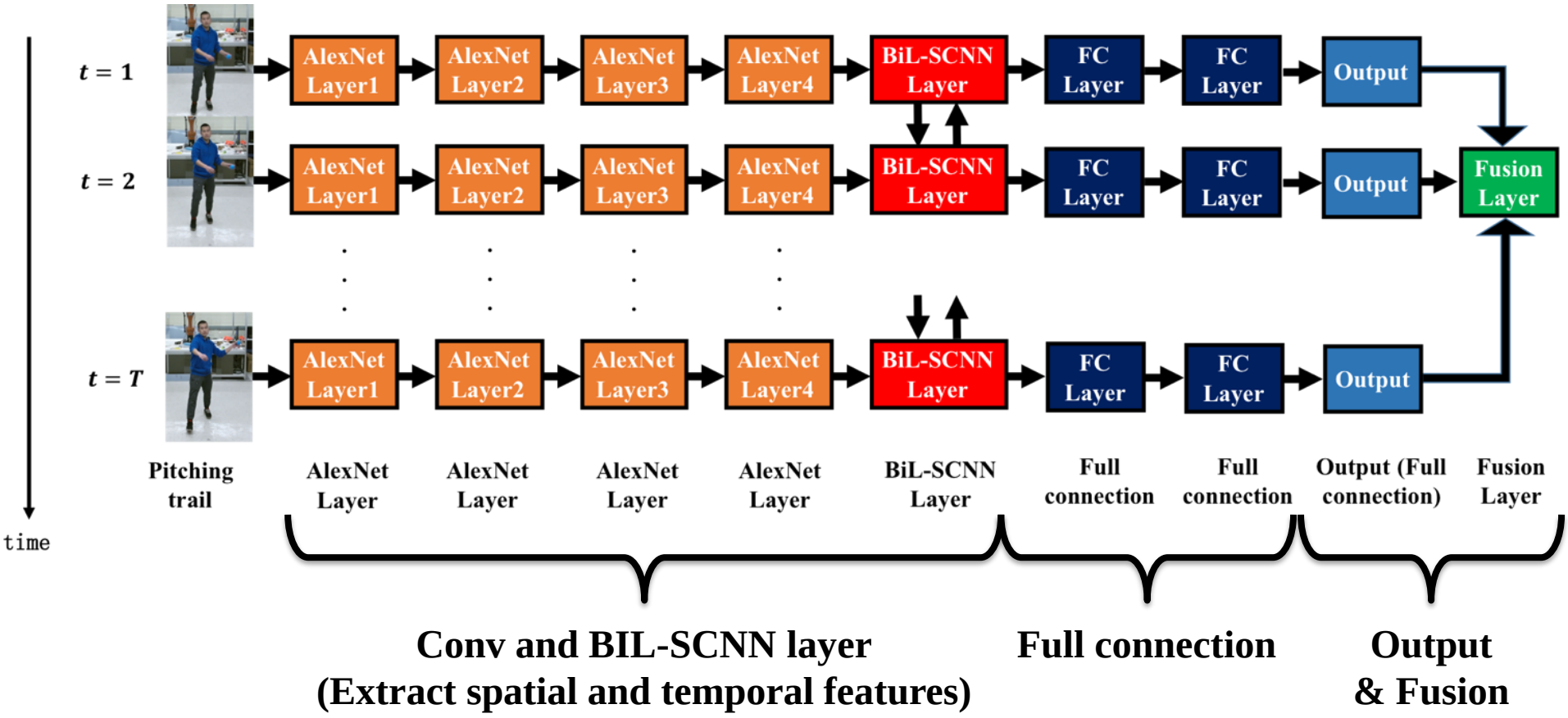
BIL-SCNN



- **Keep LSTM structure → Temporal features**
- **Replace the multiplication operation ($Wx + b$) with the convolution operation ($W * x + b$) → Spatial features**
- **Use bi-directional structure**

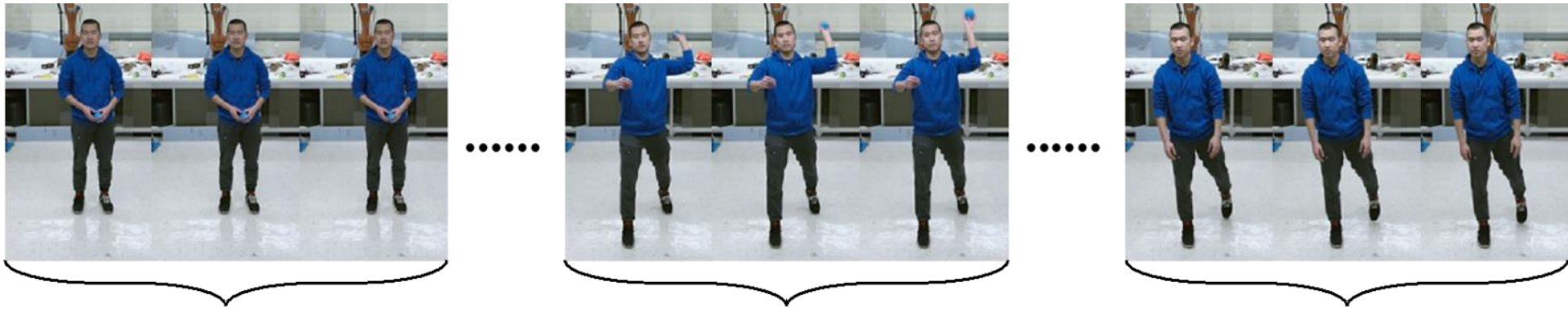
METHOD

PROPOSED NETWORK



METHOD

DETECT STARTING FRAMES



Useless frames (before pitching)

Useful frames (pitching)

Useless frames (after pitching)

Where is the beginning of the action?

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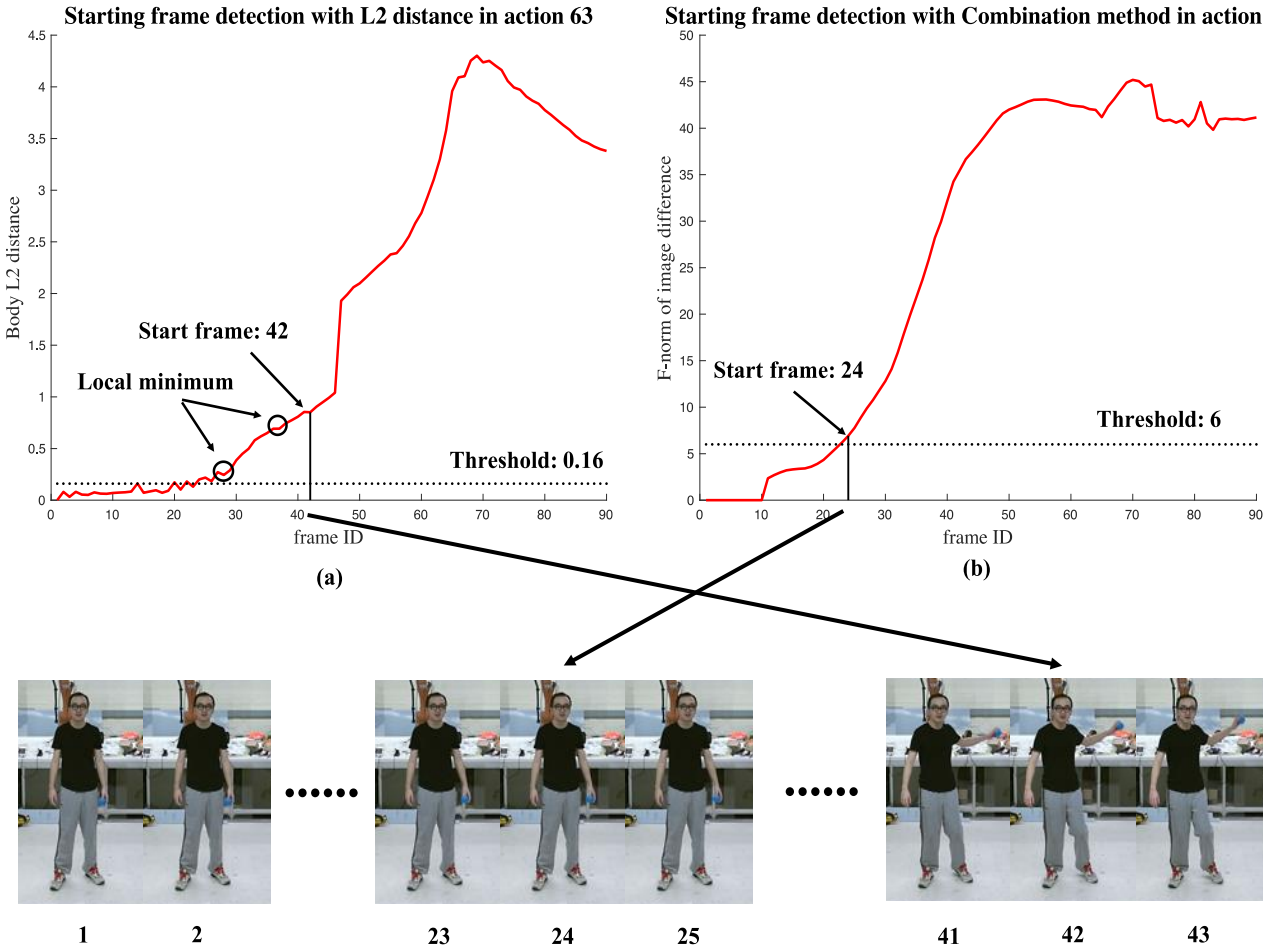
METHOD

DETECT STARTING FRAMES



A monotonically increasing period of the distance

1) Joint positions:
L2 distance of joint positions increases during the action.

2) Joint + images:
differences between images increase more smoothly. Joint position of right hand is also used to more accurately locate the starting frame

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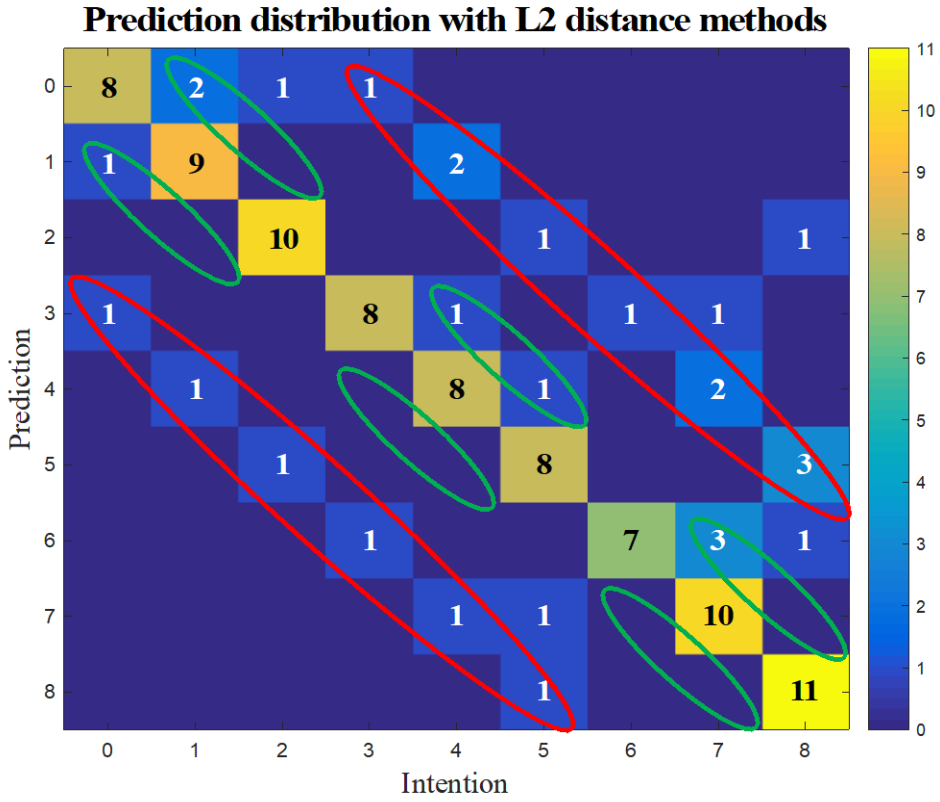
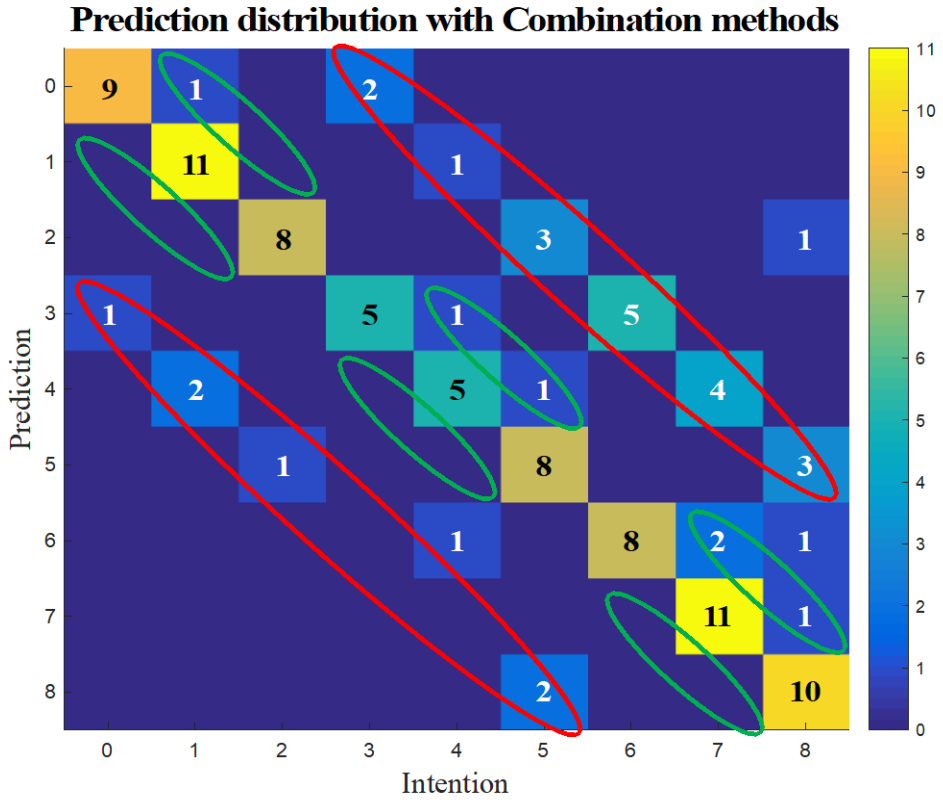
RESULTS

ACCURACY ON FULL ACTION





- **Accuracy: 73.15% (almost the same as two-stream methods in previous work)**
- **Mis-prediction mainly focuses on the neighborhood block.**
- **Vertical neighborhood errors > horizontal neighborhood errors**
  (Red circle) (Green circle)

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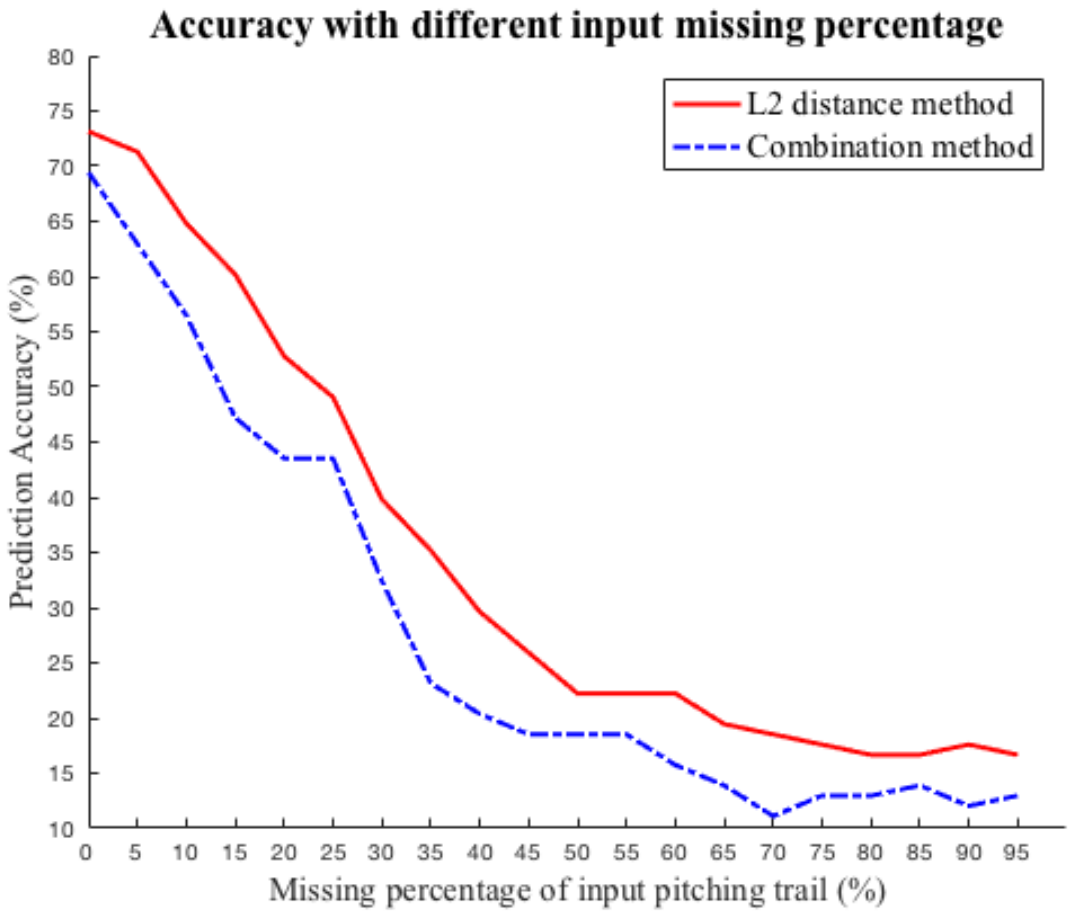
RESULTS

ACCURACY ON INCOMPLETE ACTION



- **As the missing percentage increases, the accuracy decreases.**
- **Over 50% accuracy at about 20-25% of missing input.**
- **The network loses the ability of intention prediction when the input is reduced to about 5 frames.**

CONCLUSION AND FUTURE WORK

- **Enlarge dataset: 1) Actions that outcomes differ from intentions. It can help us analyze the connection between intentions and actions. 2) Actions that from multi-view sensors. It may decrease the neighborhood errors.**

- **Explore more network architectures and implementation with Convolutional LSTM that may reach higher accuracy.**

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