VIDEO-BASED WETTING DETECTION FOR BLENDED FABRICS

Xianpeng Liu and Chau-Wai Wong

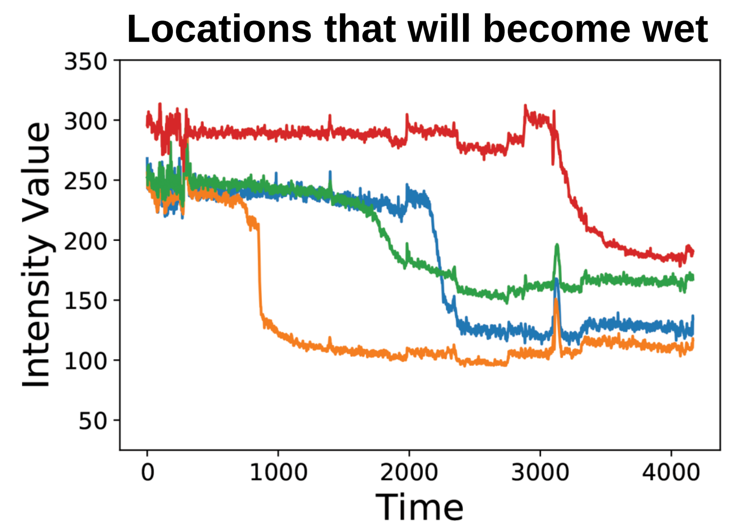
North Carolina State University, Raleigh, USA

Background: Fabrics’ Wicking Phenomenon

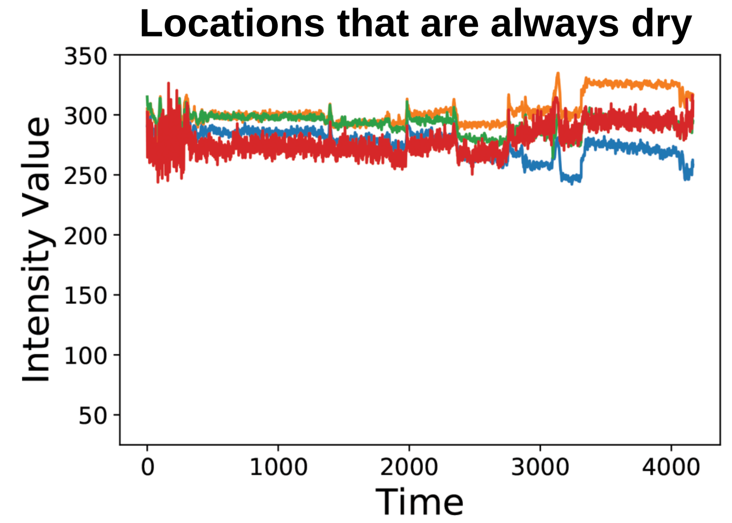
- Fabrics’ wicking performance affects the physiological comfort of clothes.
- Sportswear, military apparel segments of the textile industry seek to improve fabrics’ wicking performance.
- To develop better-performed wicking fabrics, textile scientists need to understand how liquid transports within yarns and between yarns.
- Creating an automated description of the wicking the phenomenon at the yarn-level from wicking videos can facilitate such understandings.

Research Question: Change Detection of Pixel Color

- Wicking videos capturing conditions:
  - Fabric type: blended, i.e., including both hydrophobic and hydrophilic yarns.
  - Wicking source: colored water injected into one hydrophilic yarn using a needle.
  - Capturing device: Consumer-grade mobile camera capturing the top view.
- Propose a video analysis method for i) detecting pixels that will become wet, i.e., abrupt change in color, ii) estimating timestamp of wetting event.
- Treat color of each pixel as a time series. Formulate it as a change-point detection problem.



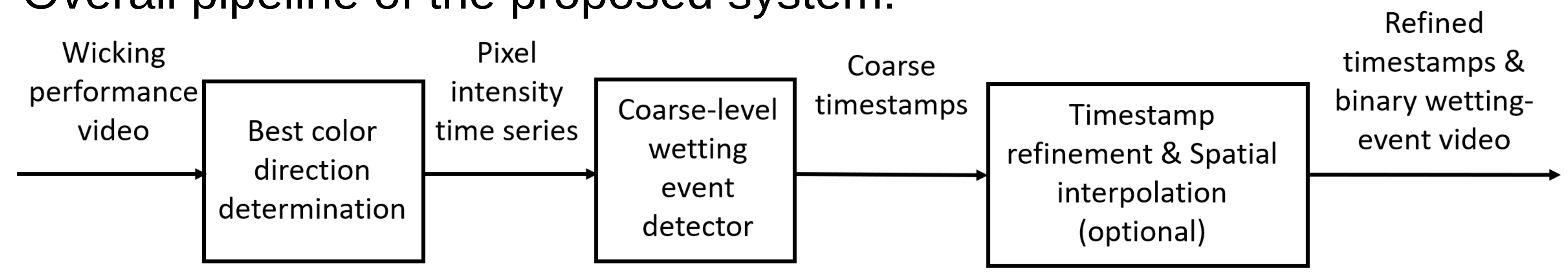
- Challenge due to various types of noise: vibration of the exp. platform, ambient light change, camera acquisition noise.
- Simple thresholding with morphological operations does not work because it may generate >1 timestamp for a noisy time series.



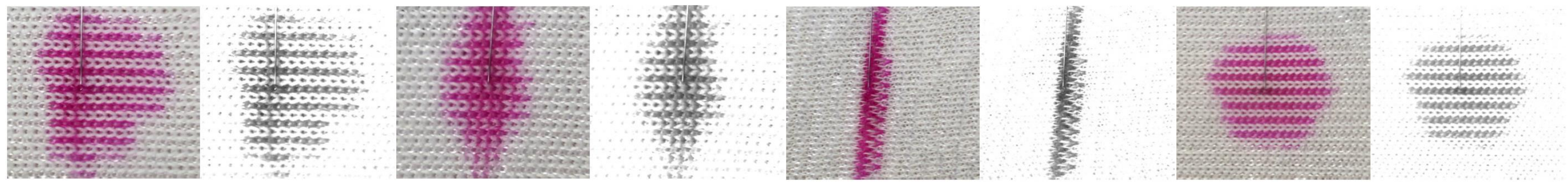
- Our proposed algorithm is designed to resist the noise and generate exactly one timestamp per pixel/location on the fabric.

Proposed Video-Based Wetting Event Detection

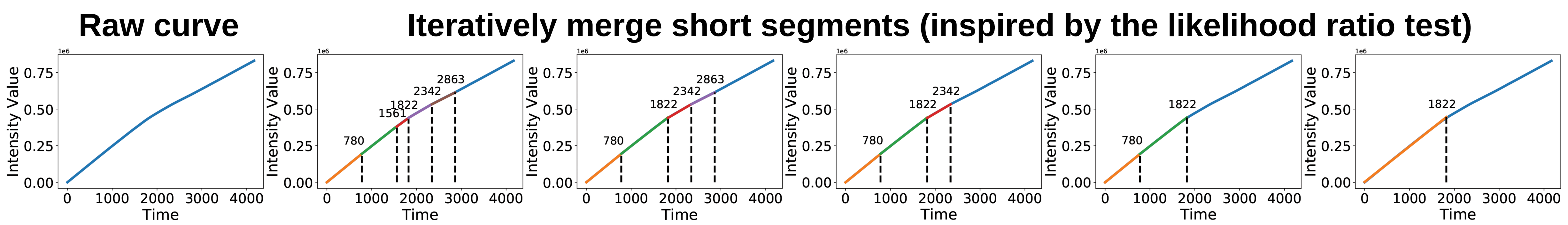
- Overall pipeline of the proposed system:



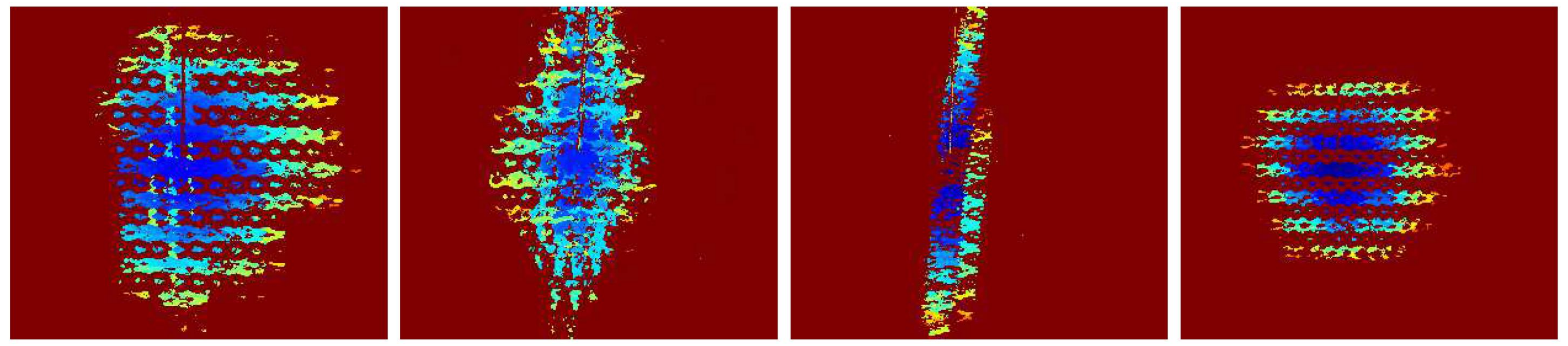
- **Determine best color direction**: Apply PCA with human intervention. Selected color direction maximizes contrast between dry and wet pixels.



- **Coarse-level wetting event detector**: To resist noise, instead of detecting the timestamp with the largest intensity change, we detect the largest slope change on the cumulative intensity curve.



- By successively merging segments of strong linearity, the region of the largest convexity will stand out, and the location of the final junction will be considered to be coarse-level wetting timestamp.
- **Timestamp refinement**: Parameterize the cumulative intensity and find the analytic expression for time of the most negative convexity.
- **Results**: Detected timestamps are consistent with wetting time shown in the original videos.



Demo: https://ncsu-wong.org/projects/wick/demo.html