NC STATE UNIVERSITY

VIDEO-BASED WETTING DETECTION FOR BLENDED FABRICS

Background: Fabrics' Wicking Phenomenon

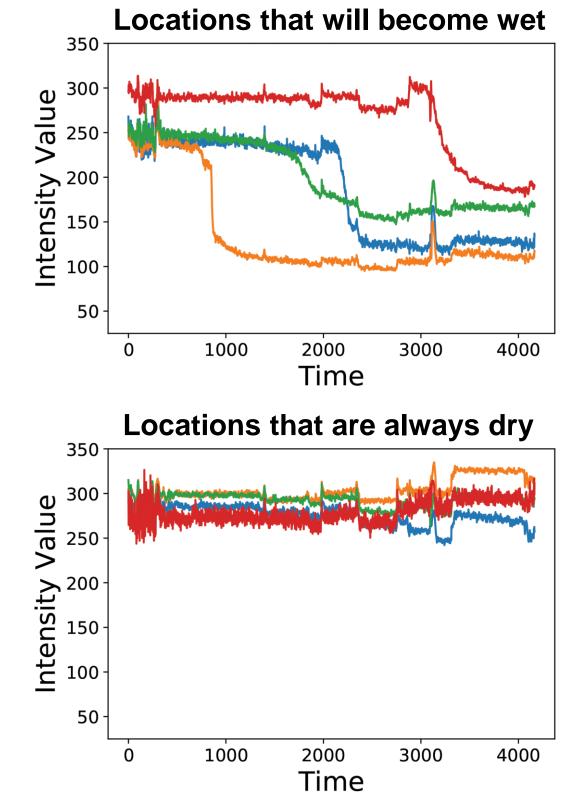
- > Fabrics' wicking performance affects the physiological comfort of clothes.
- > Sportswear, military apparel segments of the textile industry seek to improve fabrics' wicking performance.
- > To develop better-performed wicking fabrics, textile scientists need to understand how liquid transports within 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.

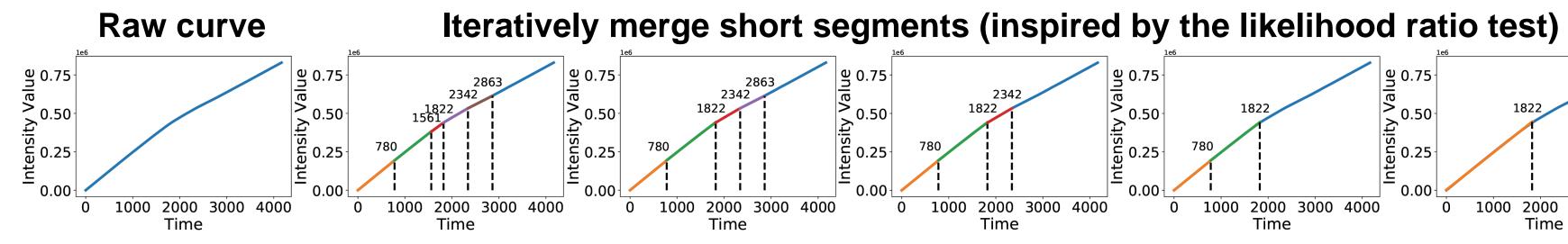
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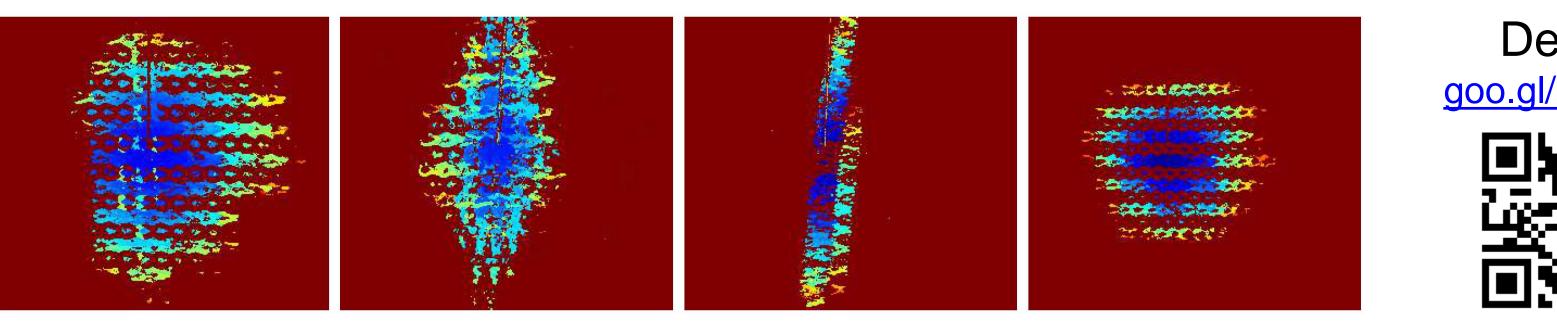
- Wicking performance video Best color direction determination

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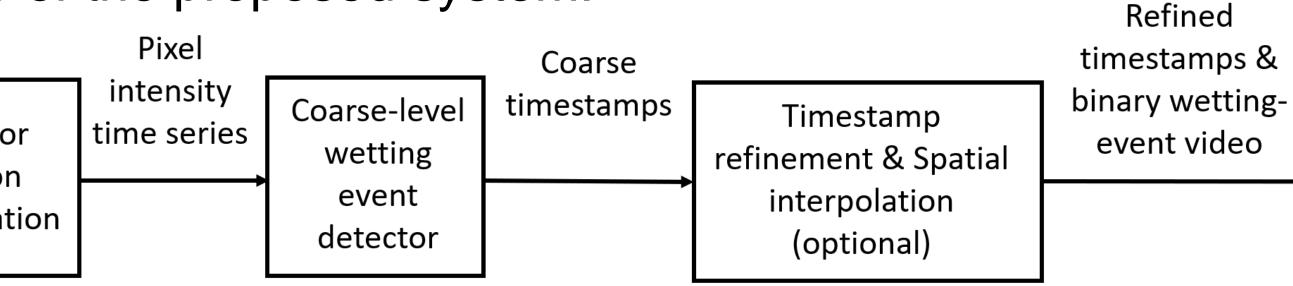


- the original videos.



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

