Eulerian Video Magnification (EVM) in Carotid Artery Image Analysis

Biao Jiang

March 29, 2018

Umeå University

Outline

EVM Method

EVM Method

- To magnify and perceive subtle temporal variations in videos
- Main techniques:
  - Image pyramid processing.
  - Temporal band-pass filtering to extract subtle changes.
  - Overlay the magnified image at a particular pyramid level to the original one.

EVM Demonstration

Time-varying Texture Features

Texture Features

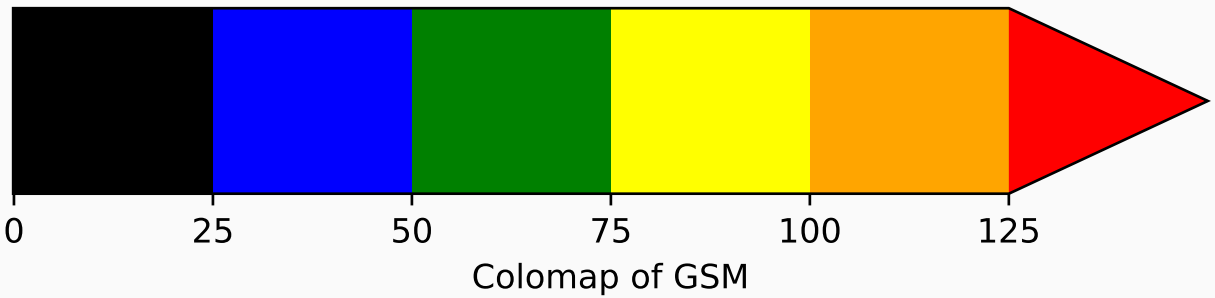

Figure 1: GSM colormap

- Gray-scale median (GSM)
- GLCM (Gray-level co-occurrence matrix)

Ultrasound Intensity Cyclic Variations

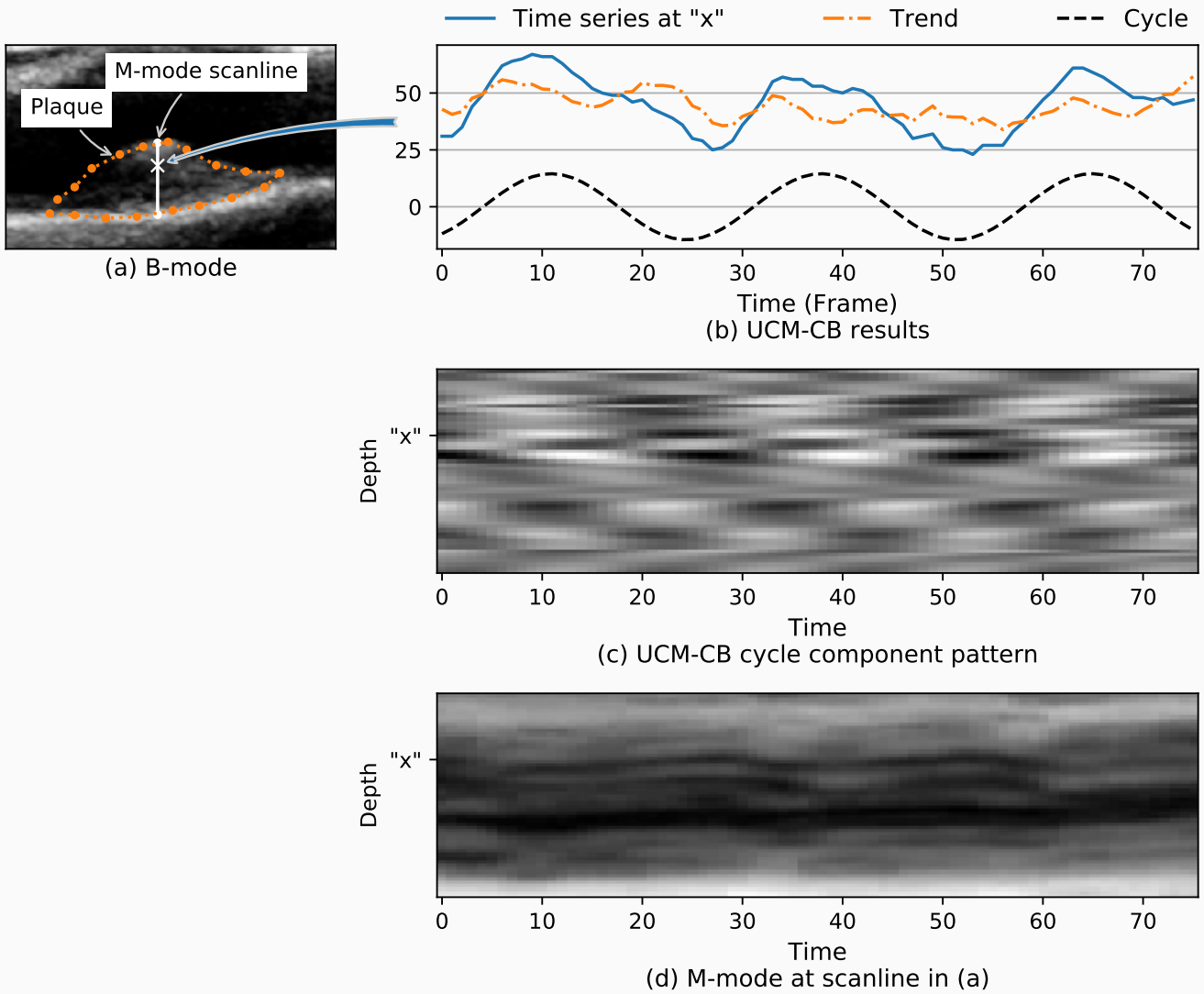

Figure 2: Intensity cyclic variations

GSM Variations

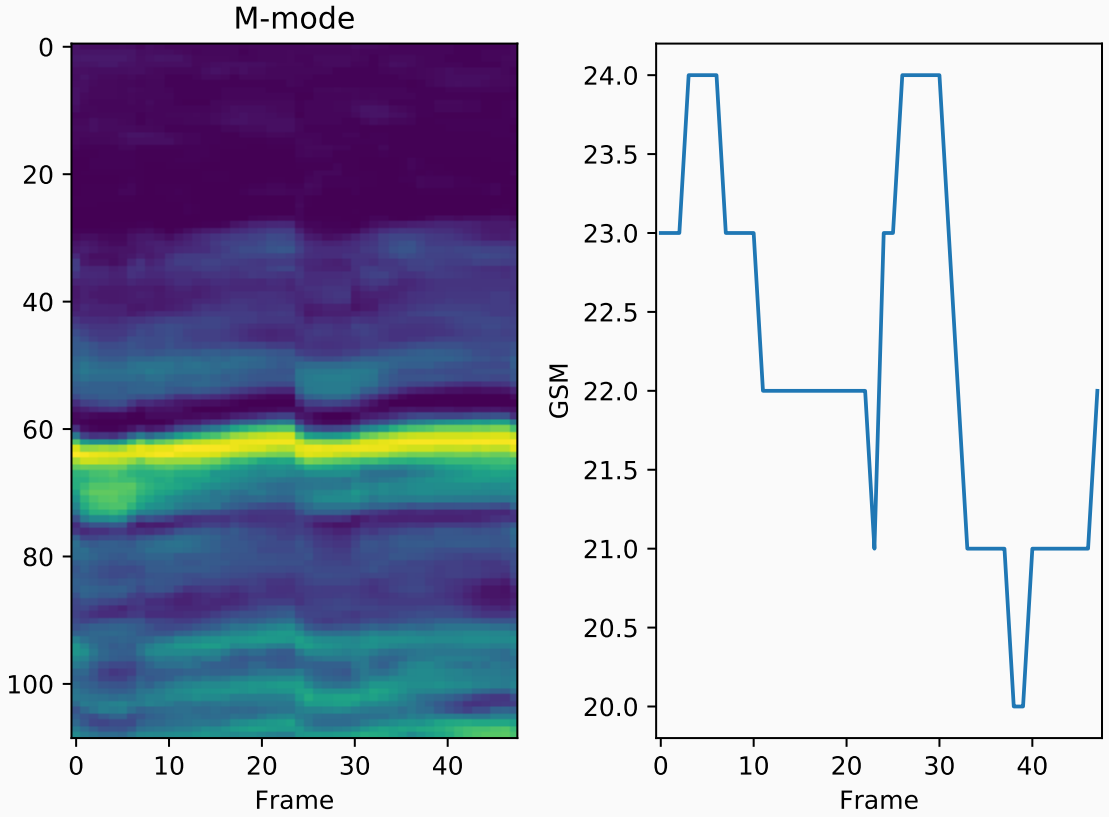

Figure 3: GSM Variations

- GSM is higher at systole than diastole.

Simulations

Effects of the Plaque Out-of-plane Motions

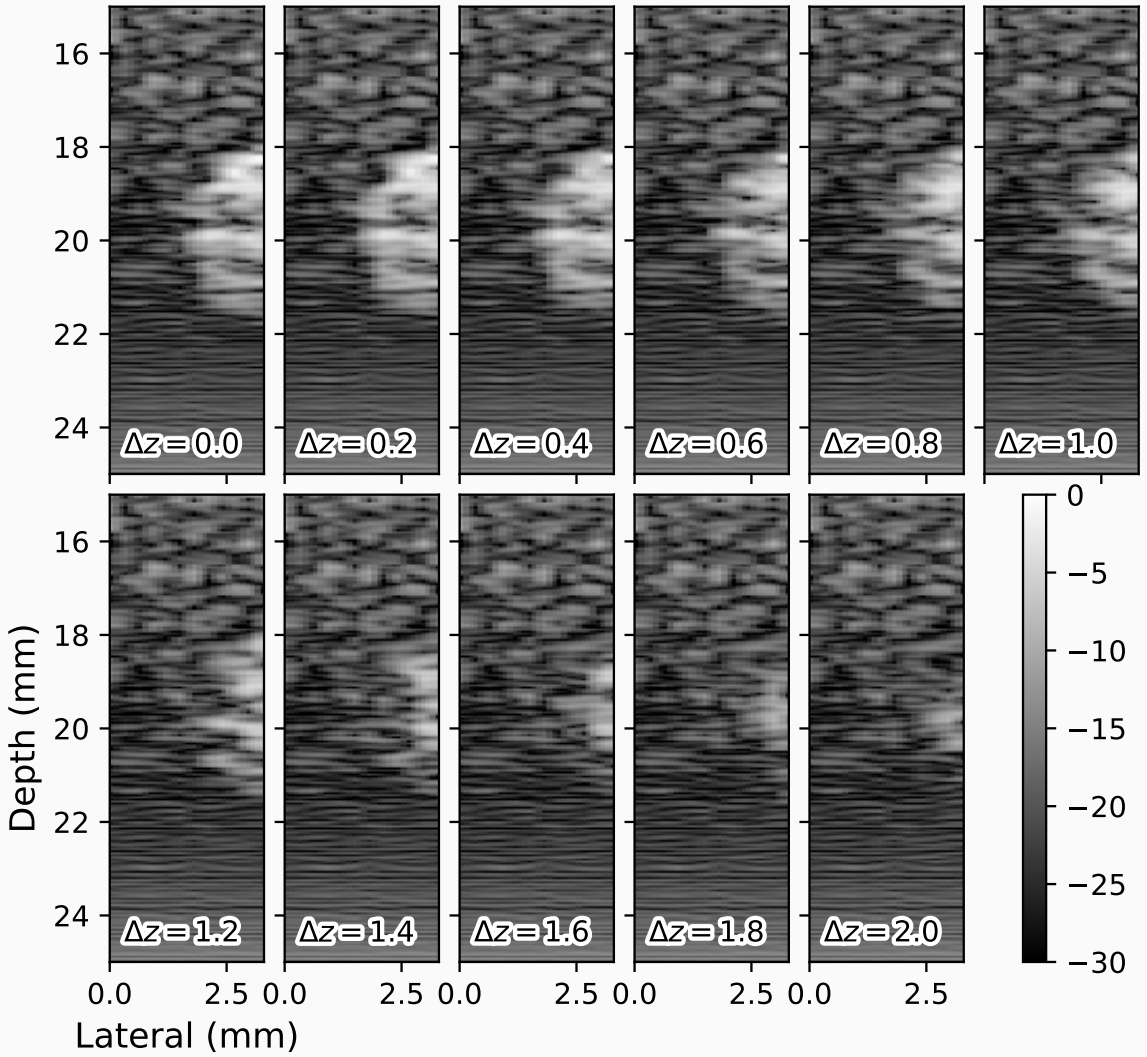

Figure 4

Effects of the Plaque Compressions

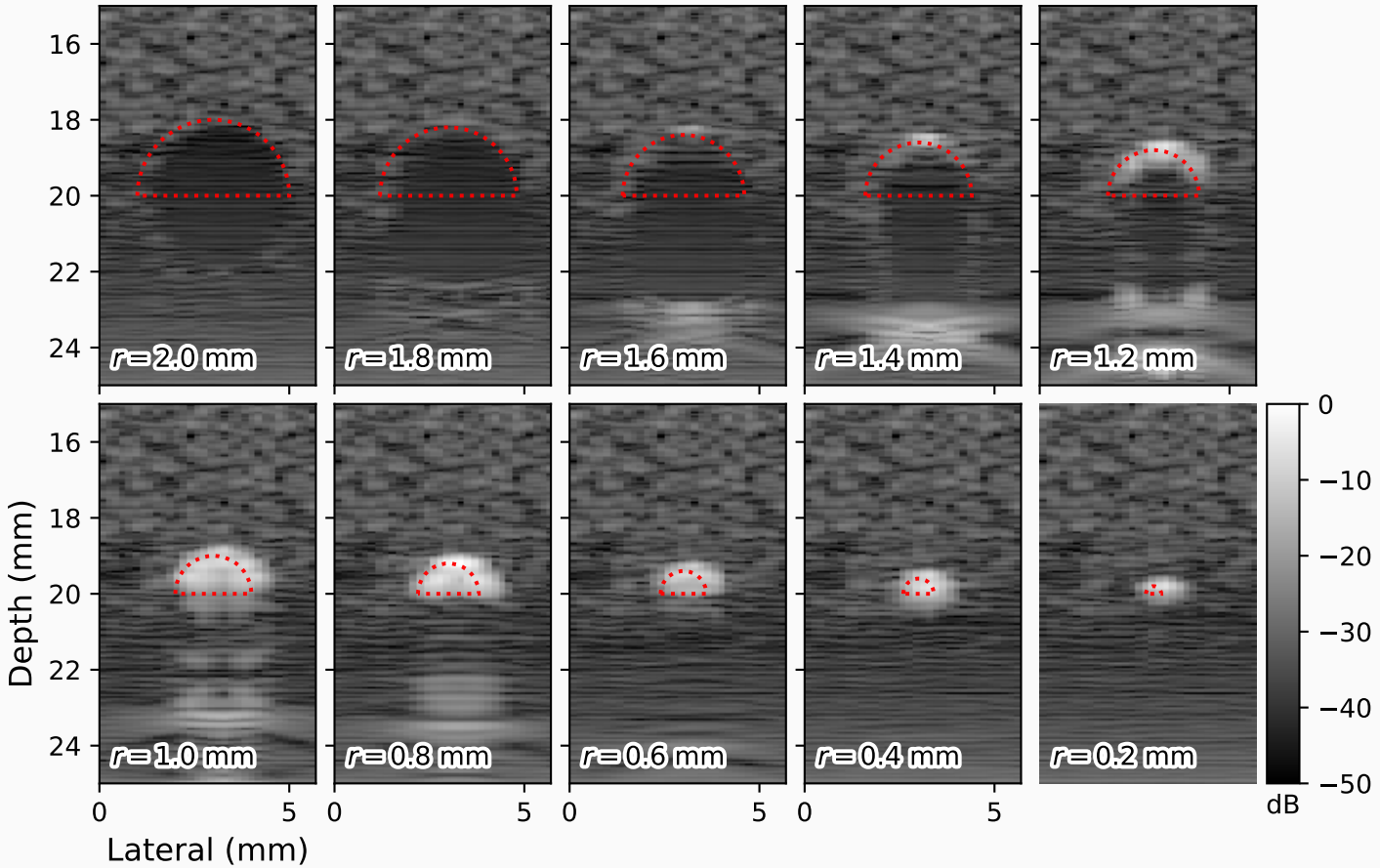

Figure 5

EVM Results

Original Sequences vs. EVM's

Original Frame vs. EVM's

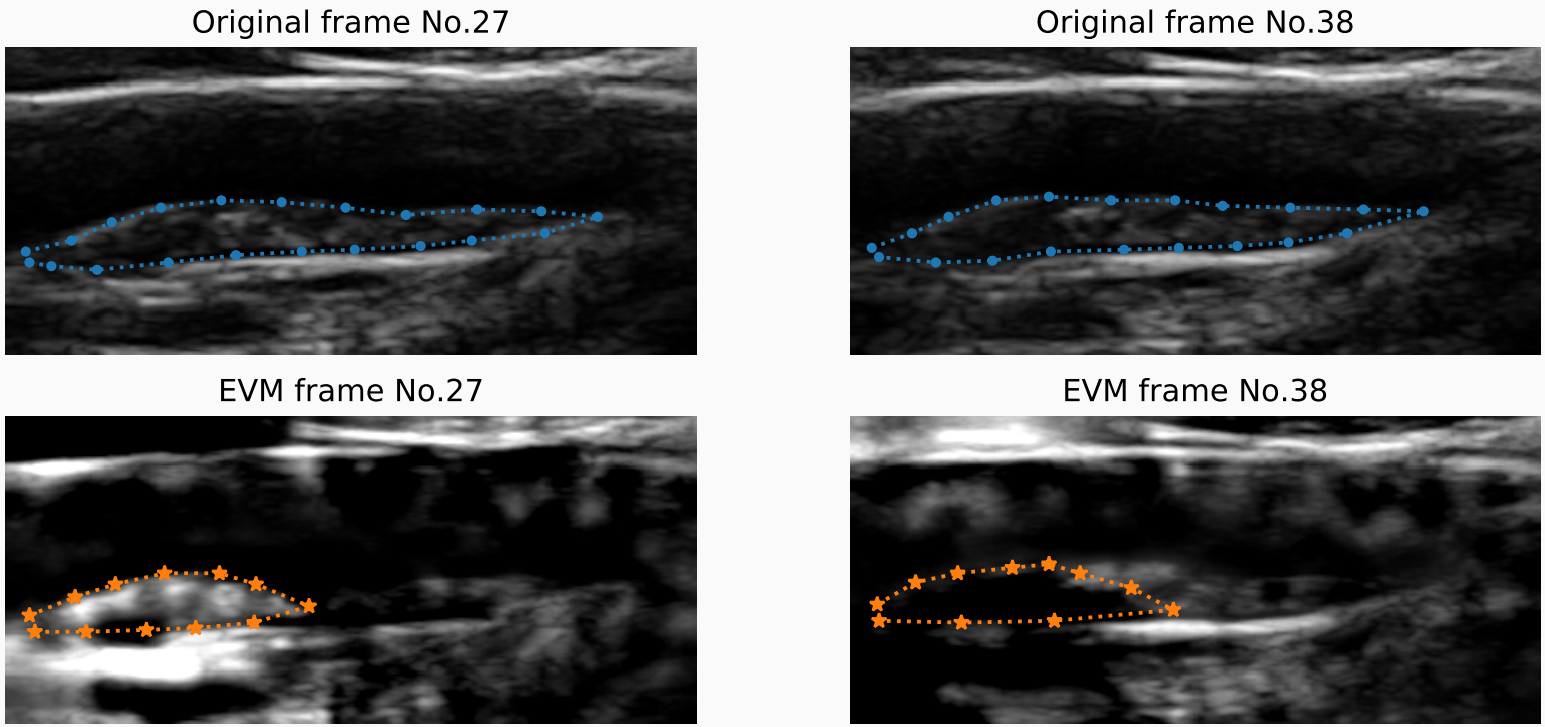

Figure 6: Carotid artery B-mode images of original vs. EVM.

EVM Applications

EVM Applications

- Magnify the whole or parts of the plaque so that it is easier to perceive/visualize.
- Improve the segmentation performance. Since some regions in the B-mode image are magnified, i.e. image signal-to-noise (SNR) is increased, thus, for edge detection, less false contour boundaries will be produced.
- More clearly observe the differences between the healthy and stiffer arteries, between the stable and unstable plaques.
- New risk-markers. By using the texture feature analyzing methods (GSM, gray-level co-occurrence matrix (GLCM), etc.) on the post-EVM image sequences.

Thank You!