SSIMWAVE
May 2023

# Toward a perceptual quality model for creative content with film grain

Hojat Yeganeh, P.hD, SMIEEE
Principal Video Architect and Research Lead

“SSIMWAVE's measurement standard represents a generational breakthrough in the video industry.”

– The Television Academy

# Agenda

- What is film grain?
- The main challenge of the existing objective VQA models in handling grain
- Texture similarity index
- Conclusion

# What is film grain?

Film grain is the visible silver crystals in a film negative's emulsion. These light sensitive silver halides change into pure metallic silver when exposed to light, which is how an image is captured on film. So, grain is an inherent part of a film image.

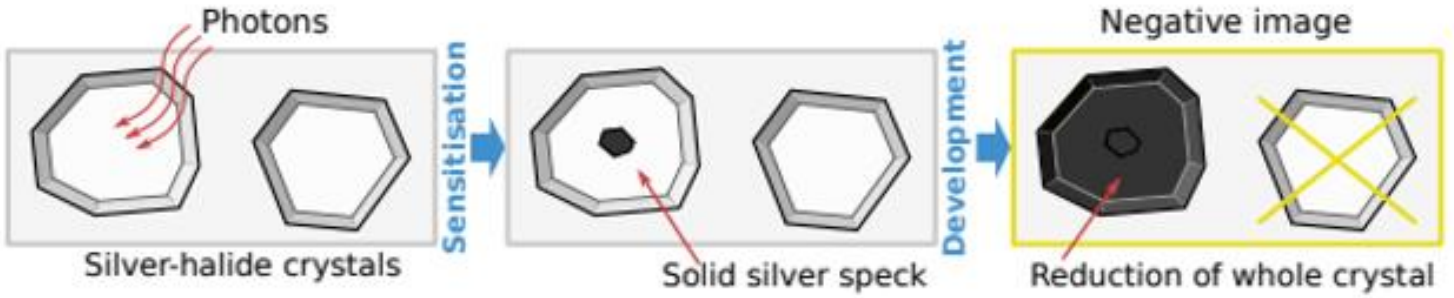



Image Credit: A Newson, et. al. "A Stochastic Film Grain Model for Resolution-Independent Rendering", Comput. Graph. (2017)

# Captured with an IMAX camera

# Captured with a Sony Venice 2 Digital camera

# Film grain's biggest challenge

- Film grain is different than sensor noise. Noise is typically an unwanted signal
- The grain is part of the creative intent and content creators adore natural film grain
  - May make video look "real" and "natural"
  - Could be used as a strong storytelling tool
  - Could be used for steering the audience's emotion

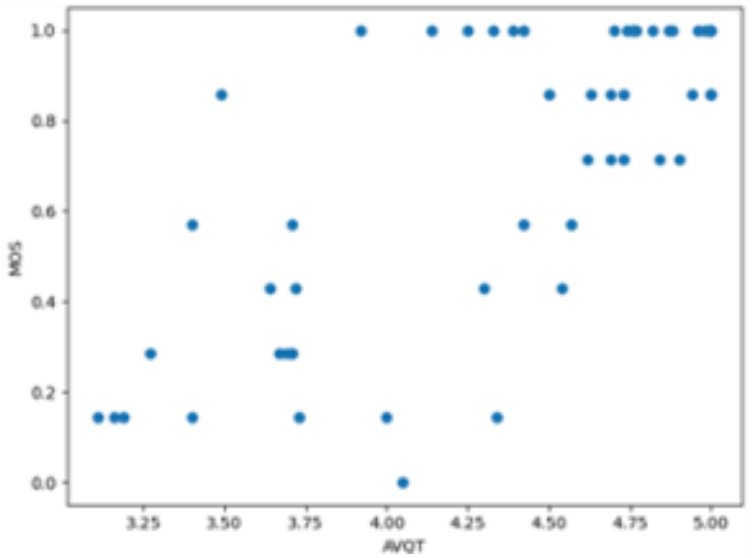
- Encoders hate film grain as it is a high entropy signal.

- The idea of film grain synthesis in modern codecs like AV1 and VVC is proposed to address this challenge

# VQA metrics fail on datasets that include film grain

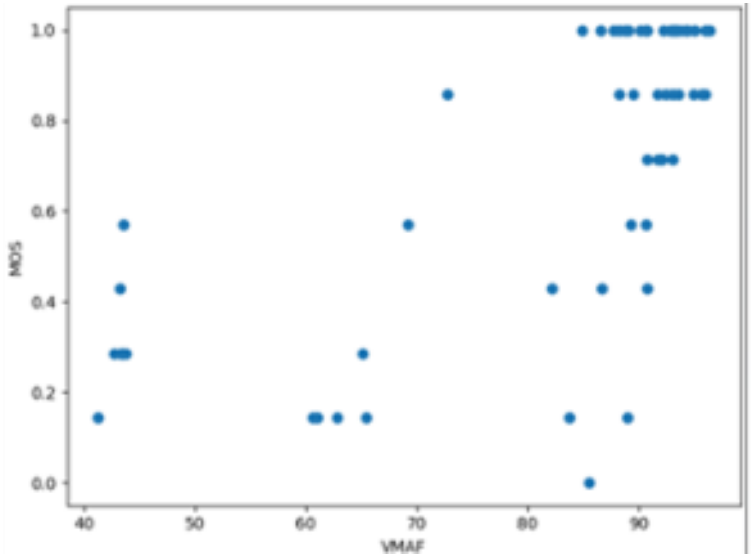
- Film grain is a kind of texture where statistical characteristics matter.
- Pixel-level fidelity measure isn’t consistent with human visual perception.

SSIMPLUS EPS



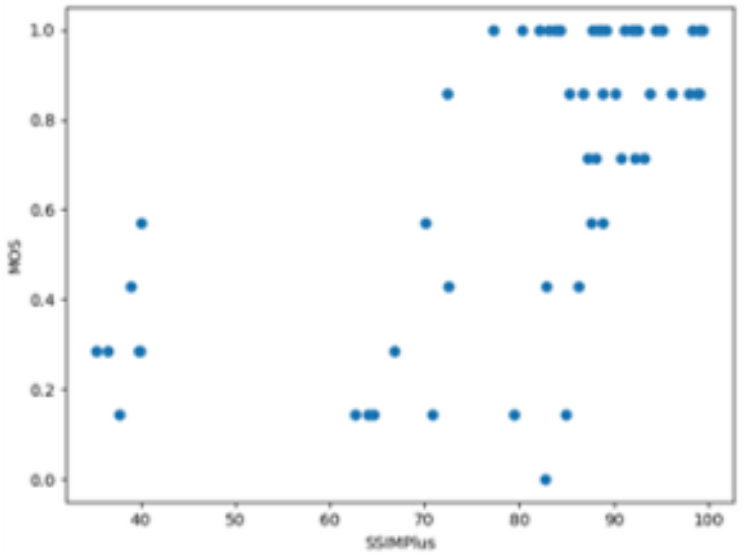

SRCC = 0.63

VMAF




SRCC = 0.60

AVQT

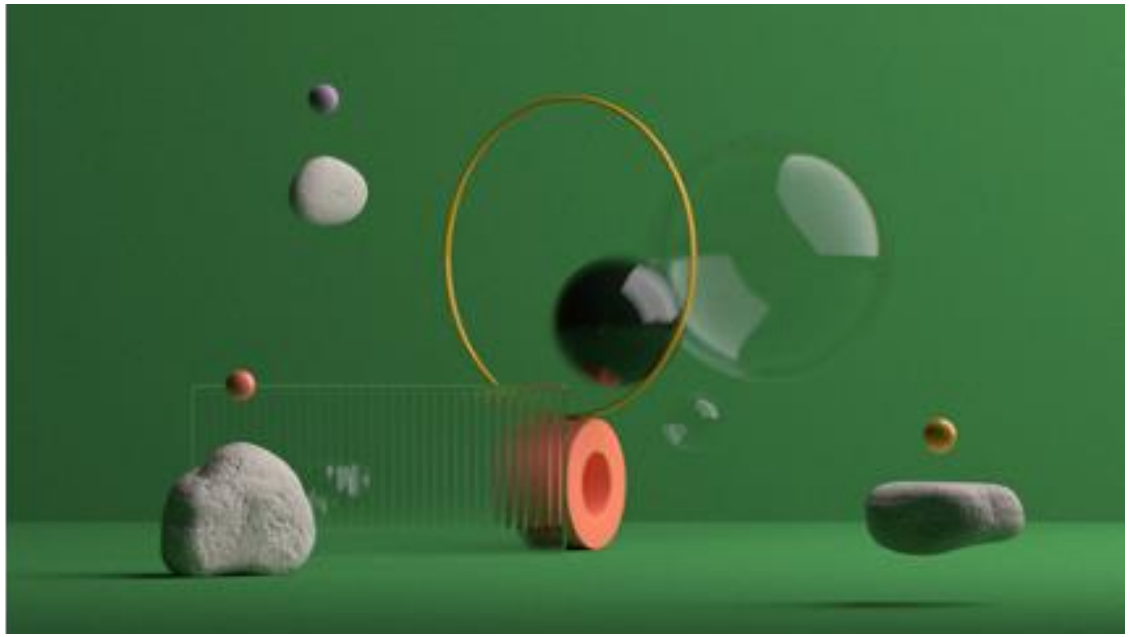



SRCC = 0.65

The above observation has been made using a SSIMWAVE internal dataset that includes film grain.

# It is very easy to fail VQA metrics

The same level of noise with the same statistical parameters is added to a pristine image to produce the reference and the test images.



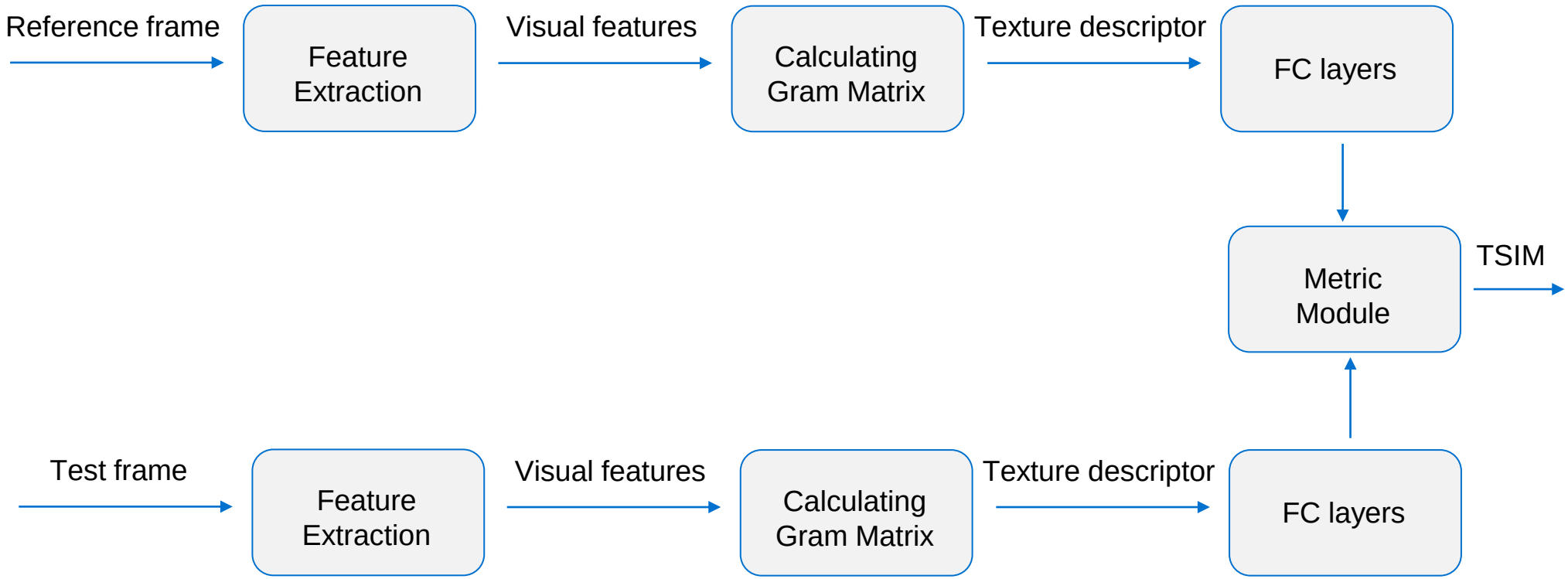
SSIMPLUS EPS = 49, VMAF = 66.50, AVQT = 2.66

# Texture Similarity Index

- Shifting the reference horizontally by 3 columns

SSIMPLUS EPS = 14, VMAF = 8.55, AVQT = 1.18

# Texture Similarity Index

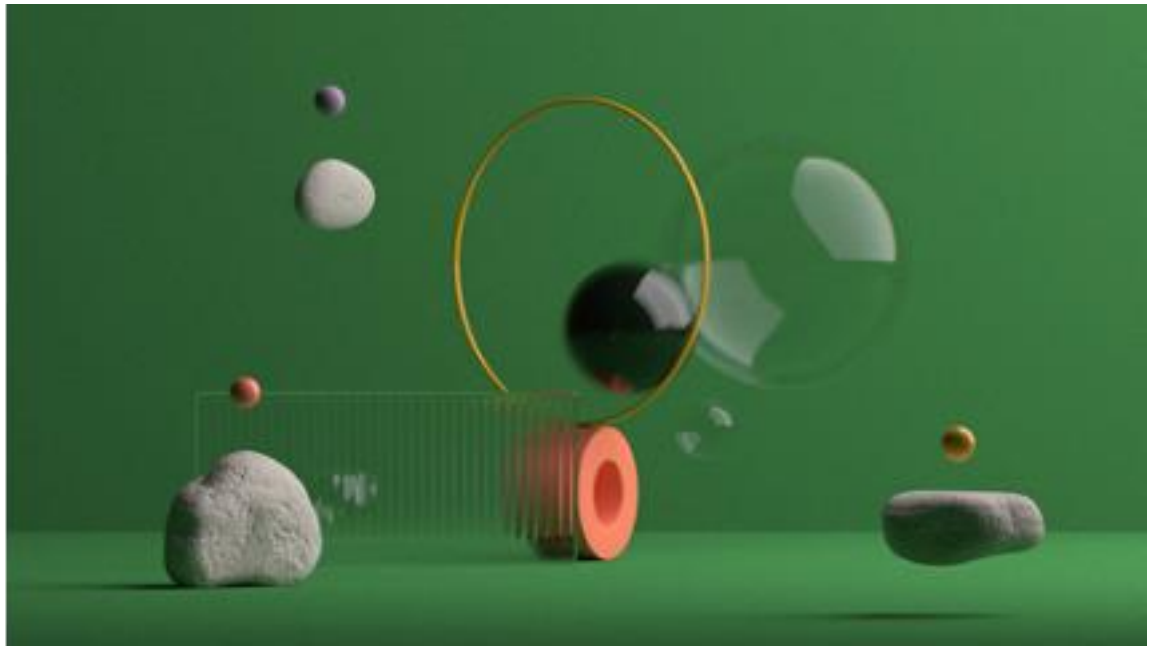


# Texture Similarity Index

- Shifting the reference horizontally by 3 columns

SSIMPLUS EPS = 14, VMAF = 8.55, AVQT = 1.18, **TSIM = 92 (out of 100)**

# Merging TSIM and SSIMPLUS EPS



SSIMPLUS EPS = 49, VMAF = 66.50, AVQT = 2.66, **SSIMPLUS Texture-aware score = 91.45**

# Merging TSIM and SSIMPLUS EPS

SSIMPLUS EPS = 69, VMAF = 77.60, AVQT = 3.07, **SSIMPLUS Texture-aware score = 91.86**

# Conclusion

- Full reference metrics are typically sensitive to structural detail loss
- The Human Visual System (HVS) tends to perceive the overall statistical characteristics of textures or film grain and is less sensitive to the structural distortions to the texture or film grain instantiates
- A preliminary texture similarity model is presented that provides promising results
- This is a research topic but is very critical in advancing the field of preserving creative intent with a focus on preserving film grain

# Thank you

**Hojat Yeganeh**

hojat.yeganeh@ssimwave.com