

ClearMR 1.1: Reducing the Noise

Frank Seto¹, Dale Stoltzka¹, Dong-Yeol Yeom², and Yongwoo Yi²
August 22, 2024

¹ Samsung Display America Lab

² Samsung Display Co., Ltd.

iMID 2024



Overview



VESA CERTIFIED
ClearMR

- ClearMR overview
- Technical improvements in ClearMR1.1
 - Accommodation for smaller & faster displays
 - Ensemble averaging



Overview

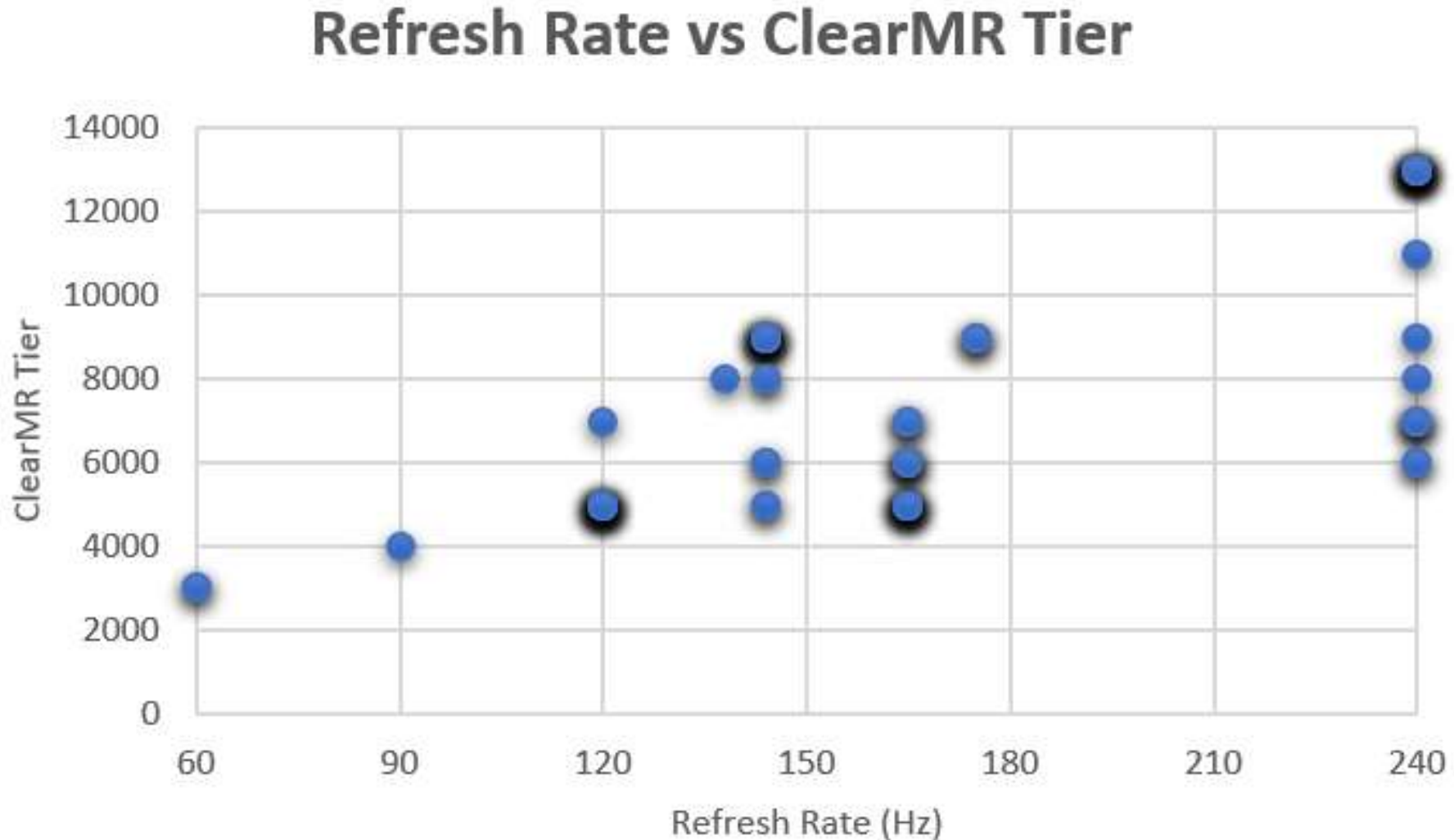


VESA CERTIFIED
ClearMR

- Only certified, open, industry standard for grading motion blur in digital displays
- Clear Motion Ratio (CMR) –
ratio of clear pixels to blurry ones



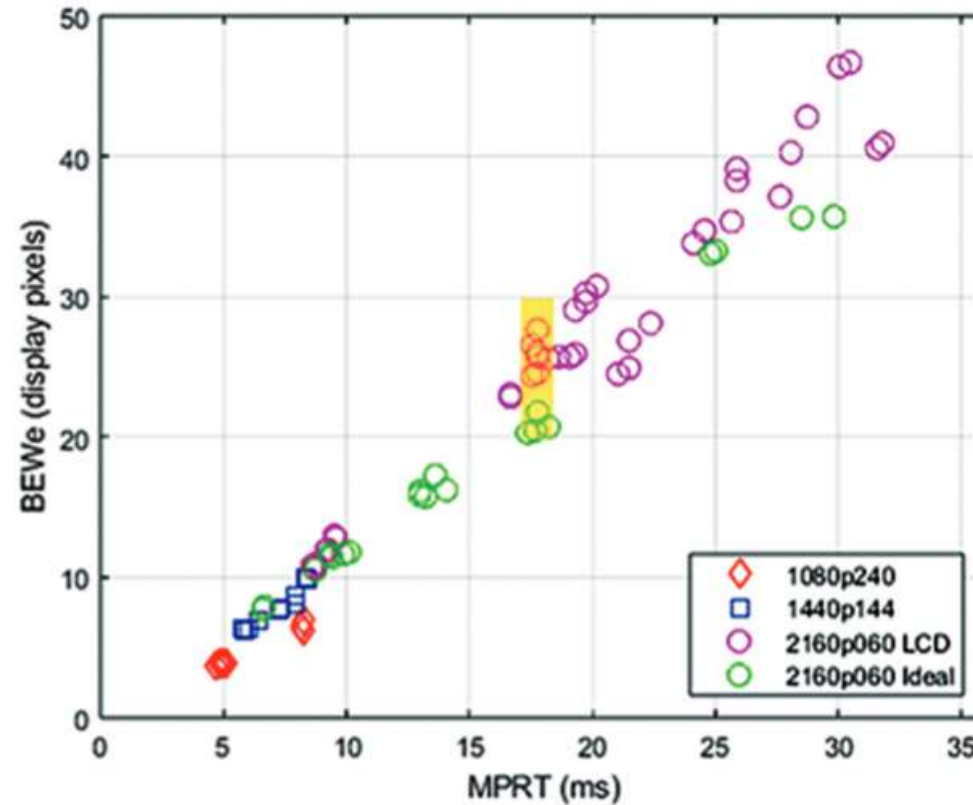
Refresh rate is poor proxy for motion blur



<https://www.clearmr.org/certified-products/> accessed 1/12/2024.

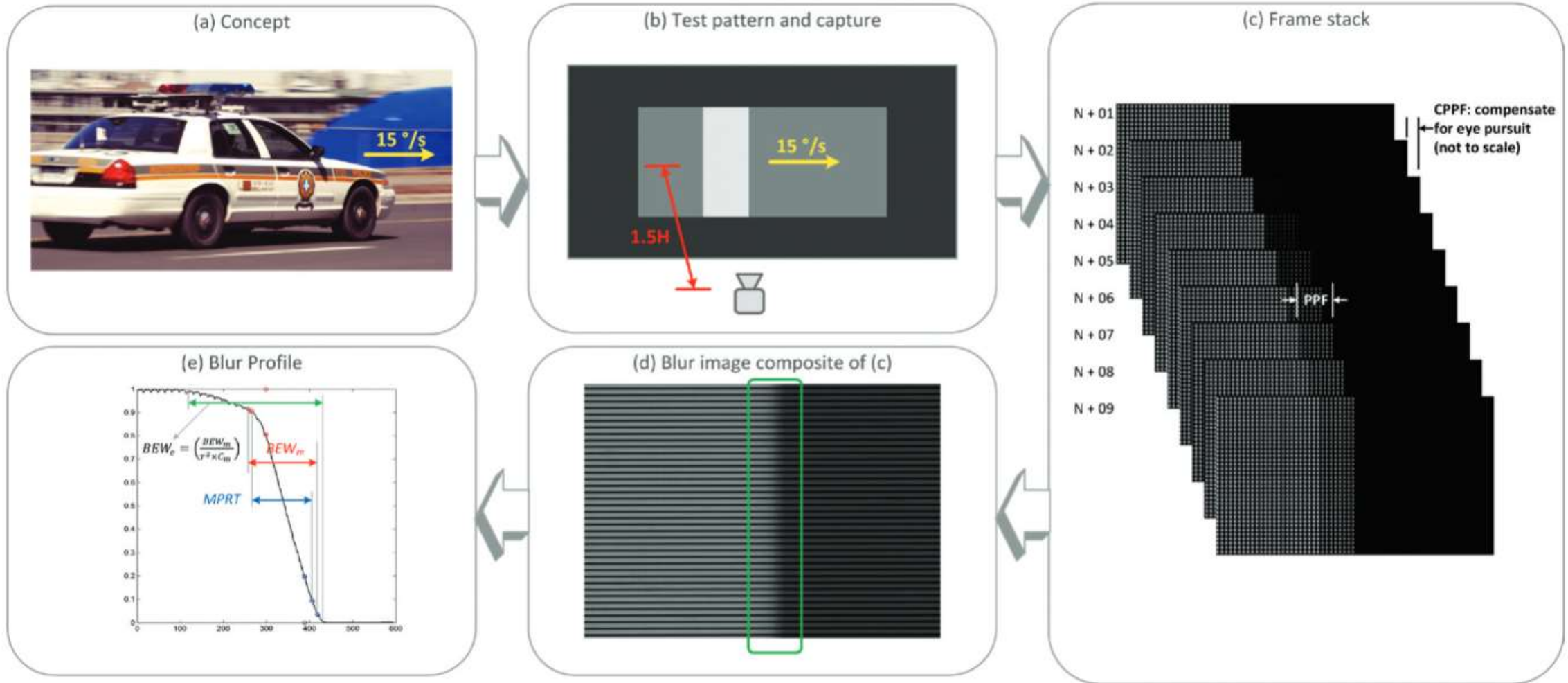
MPRT / GtG

- No compliance program has adopted it
- Varying test conditions...
 - “Typical”? “Best”?
 - Luminance?
 - Overdrive?



MPRT lack of correlation ($r^2 = 0.83$) with the effective blur edge width (BEWe) spanning all luminance.

ClearMR computation flow



ClearMR 1.1 Technical Improvements

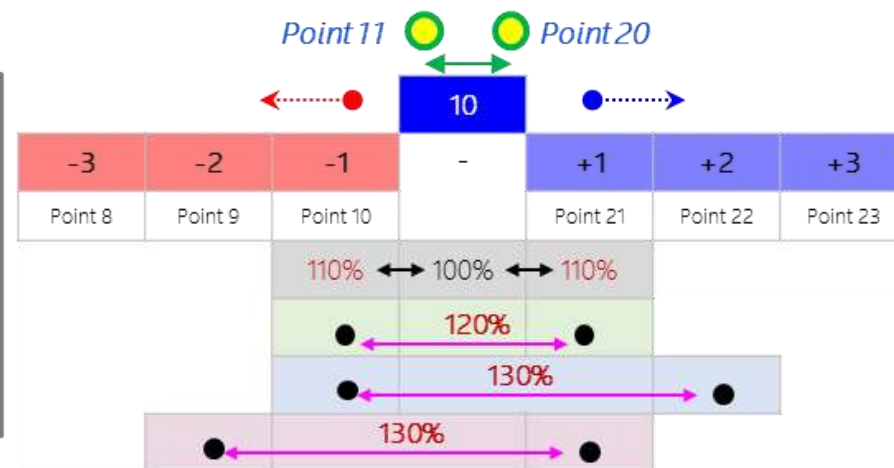
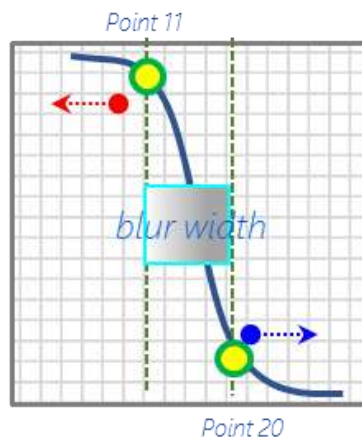
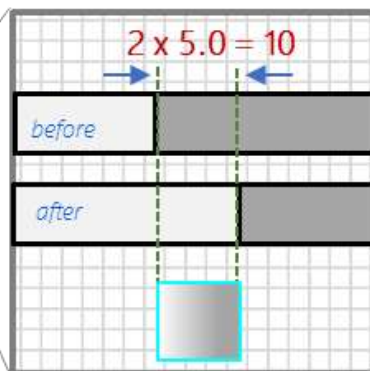
- **Challenges in high-speed digital pursuit**
 - Sensitive to optical-to-electrical noise
- **Improvements in 1.1:**
 - smaller displays with higher pixel density were measured with far fewer camera pixels than larger display counterparts. The effect allowed the optical noise to introduce a more significant error and disadvantage to smaller displays
 - a statistical averaging method is introduced, referred to as ensemble averaging, increases robustness against noise and improves consistency of results; while maintaining compatibility with previous results

Improved support for smaller and faster displays

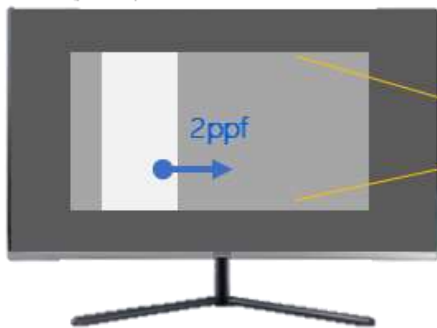
QHD / 240Hz



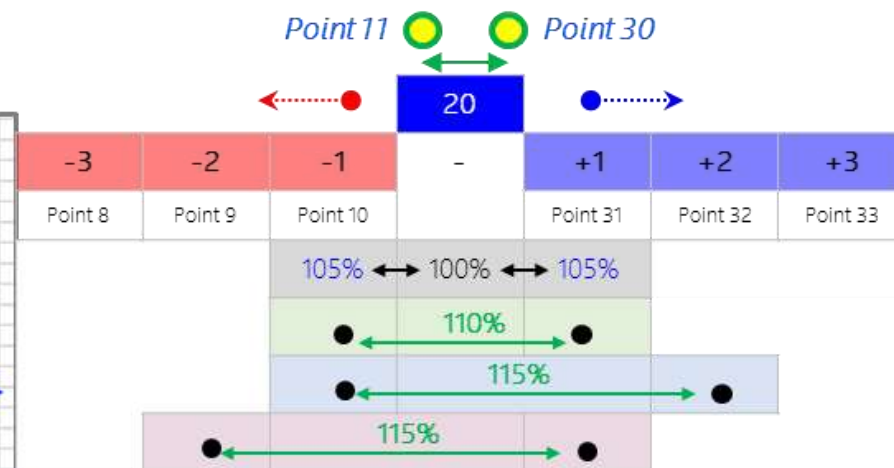
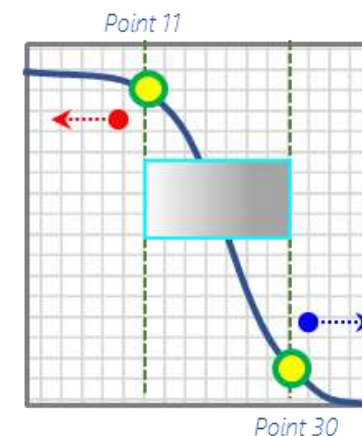
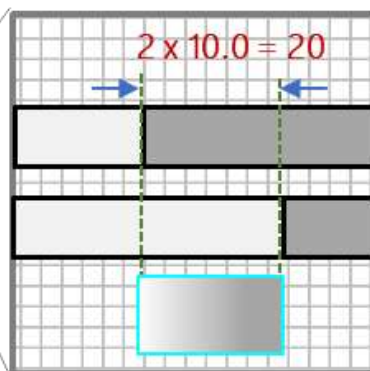
Scale = 5.0



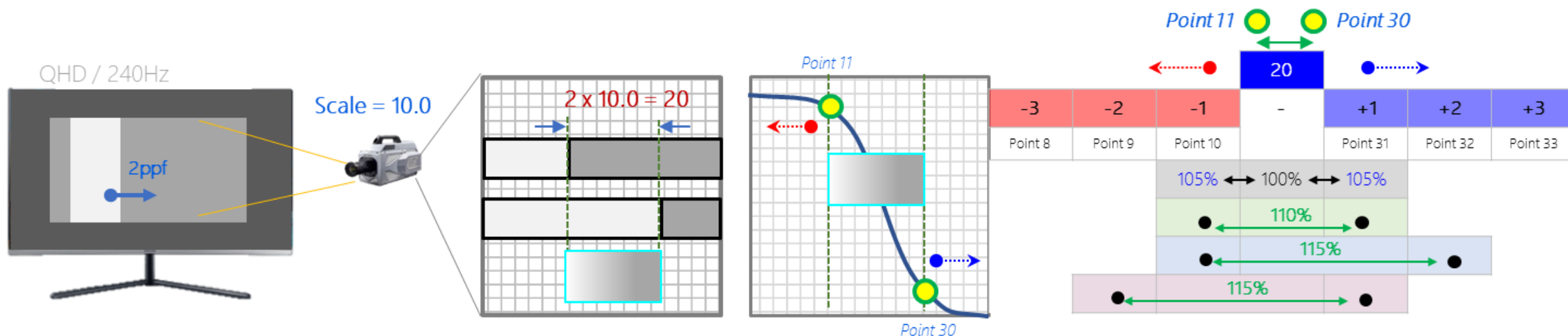
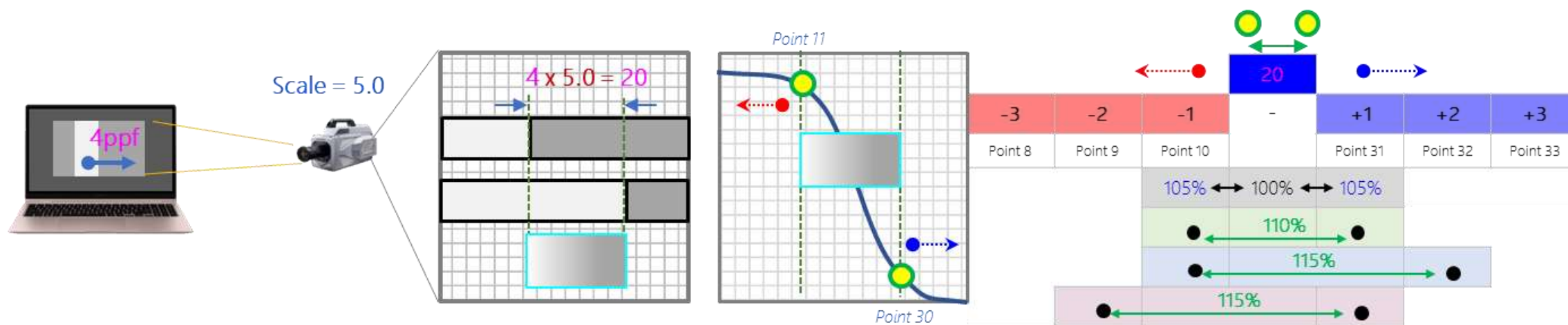
QHD / 240Hz



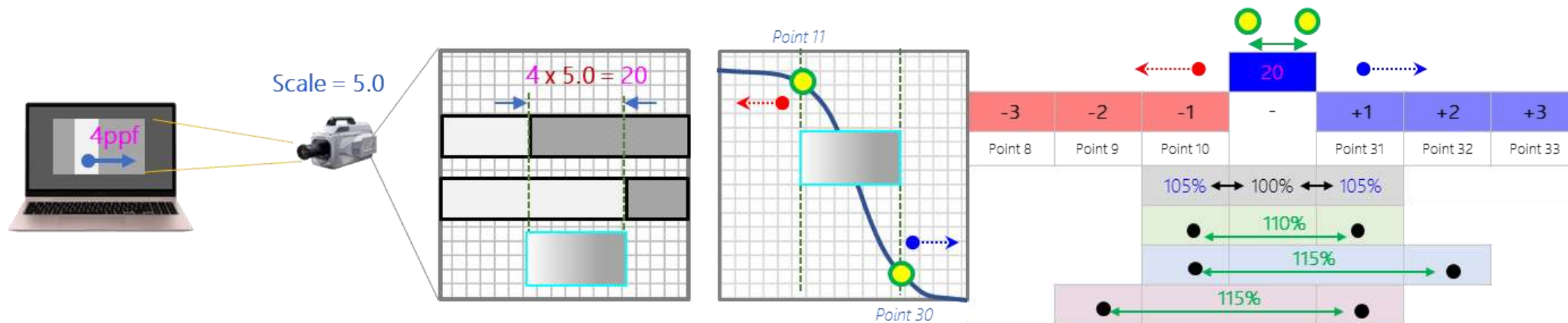
Scale = 10.0



Allowed testing at higher PPF under certain conditions



Allowed testing at higher PPF under certain conditions



- Allow measuring at a higher PPF, so any noise effect would be equal.
- If α is over 110%, the PPF would be adjusted until that condition is met.

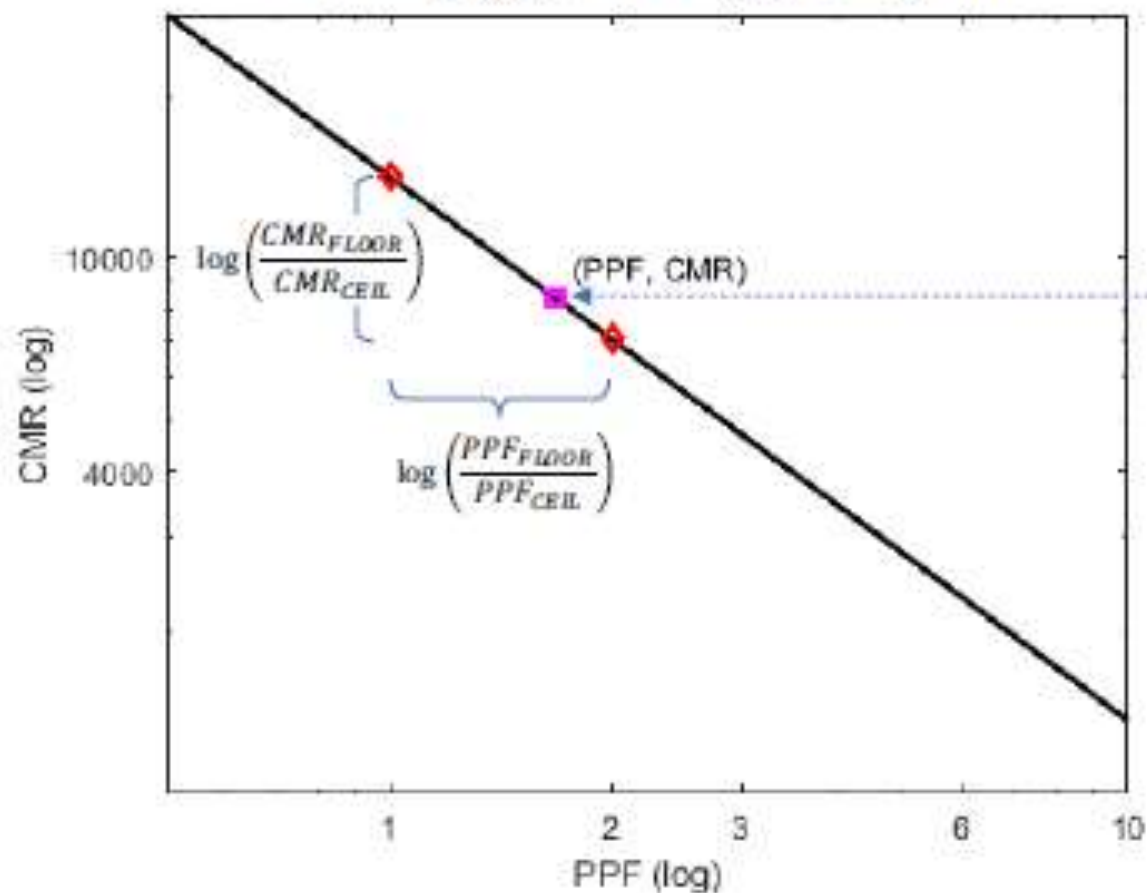
M_{ideal} is the ideal magnification

PPF is the ideal PP

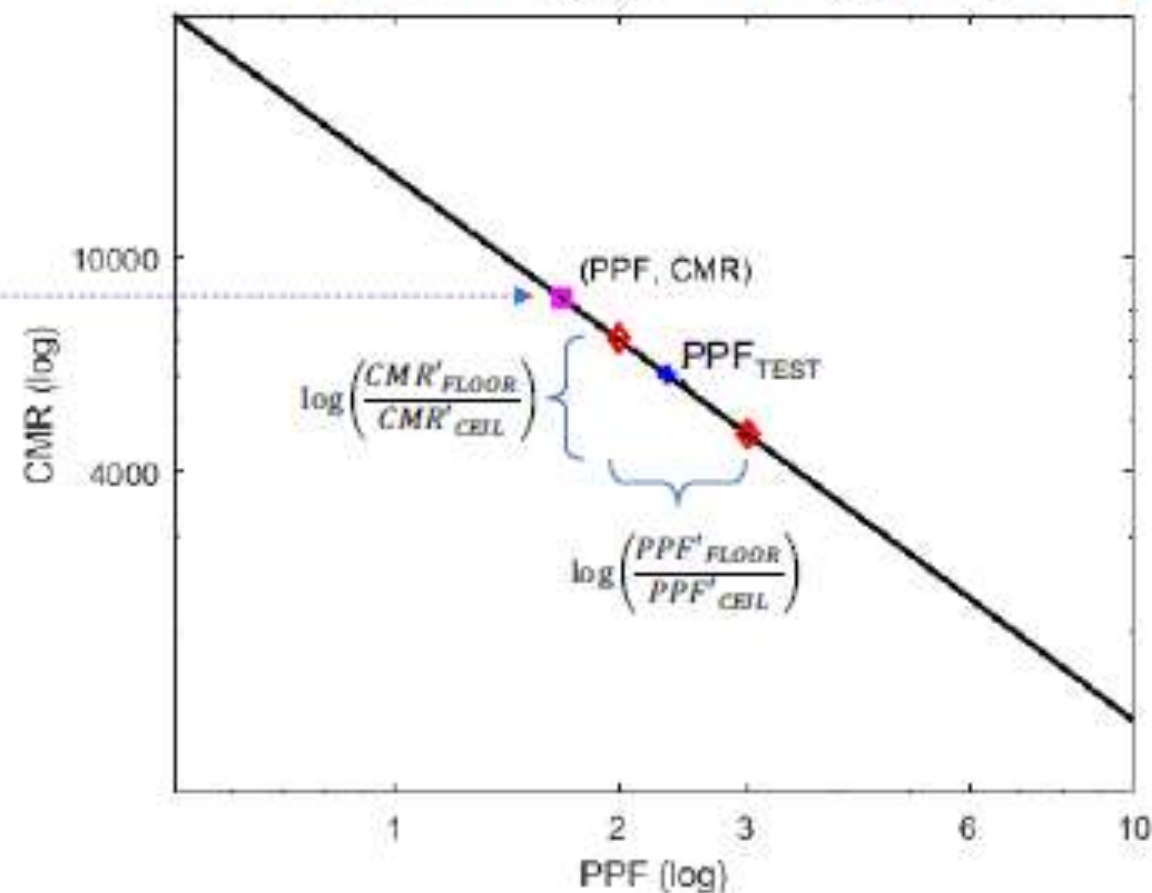
$$\alpha = \frac{M_{ideal} \times PPF + 1}{M_{ideal} \times PPF - 1}$$

Example

27", PPF_{FLOOR} and PPF_{CEIL} set by PPF



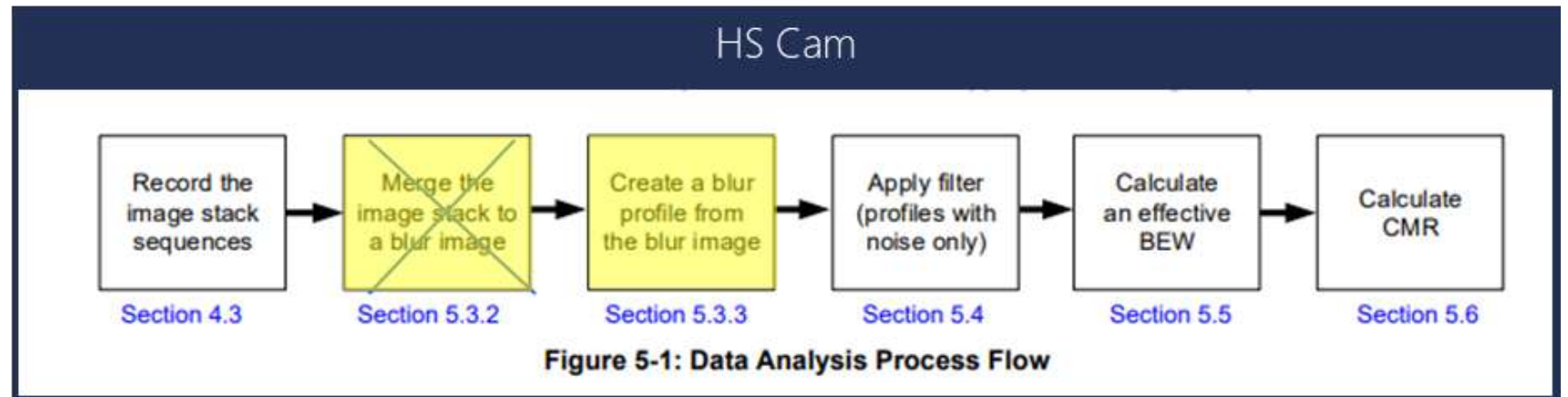
15.6", PPF_{FLOOR} and PPF_{CEIL} set by PPF_{TEST}



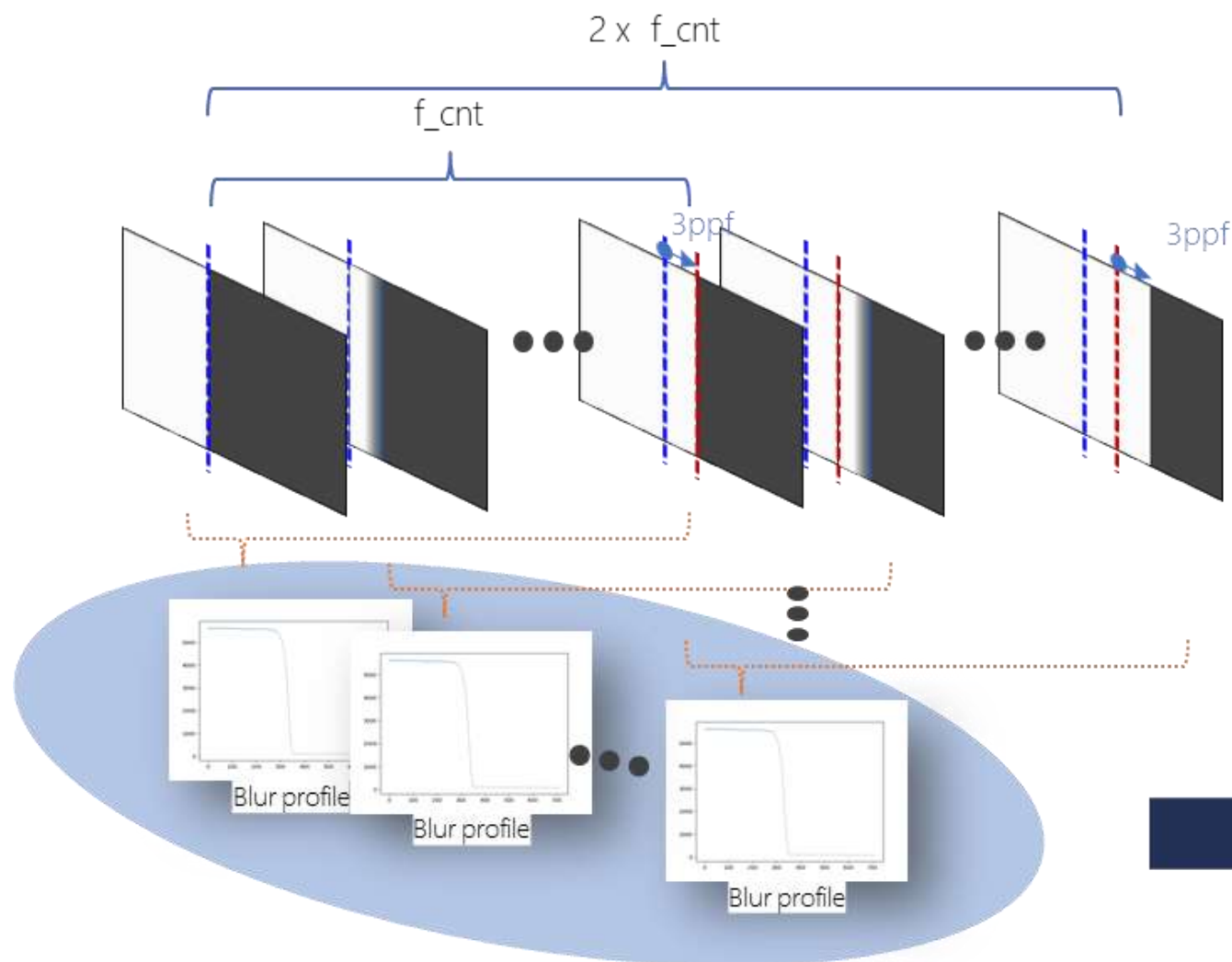
Ensemble Averaging

- **Objective**
 - Improve consistency in CMR results and robustness against noise.
- **What is it?**
 - Averaging noisy signals over multiple iterations in time (used in heartbeat / EKG / etc)

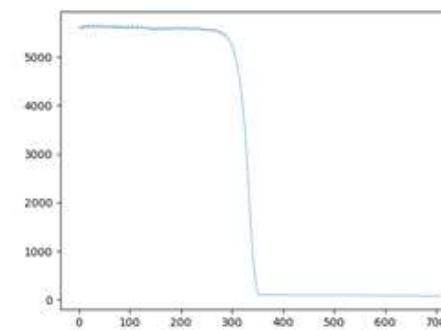
Pattern
Generator



Ensemble Averaging



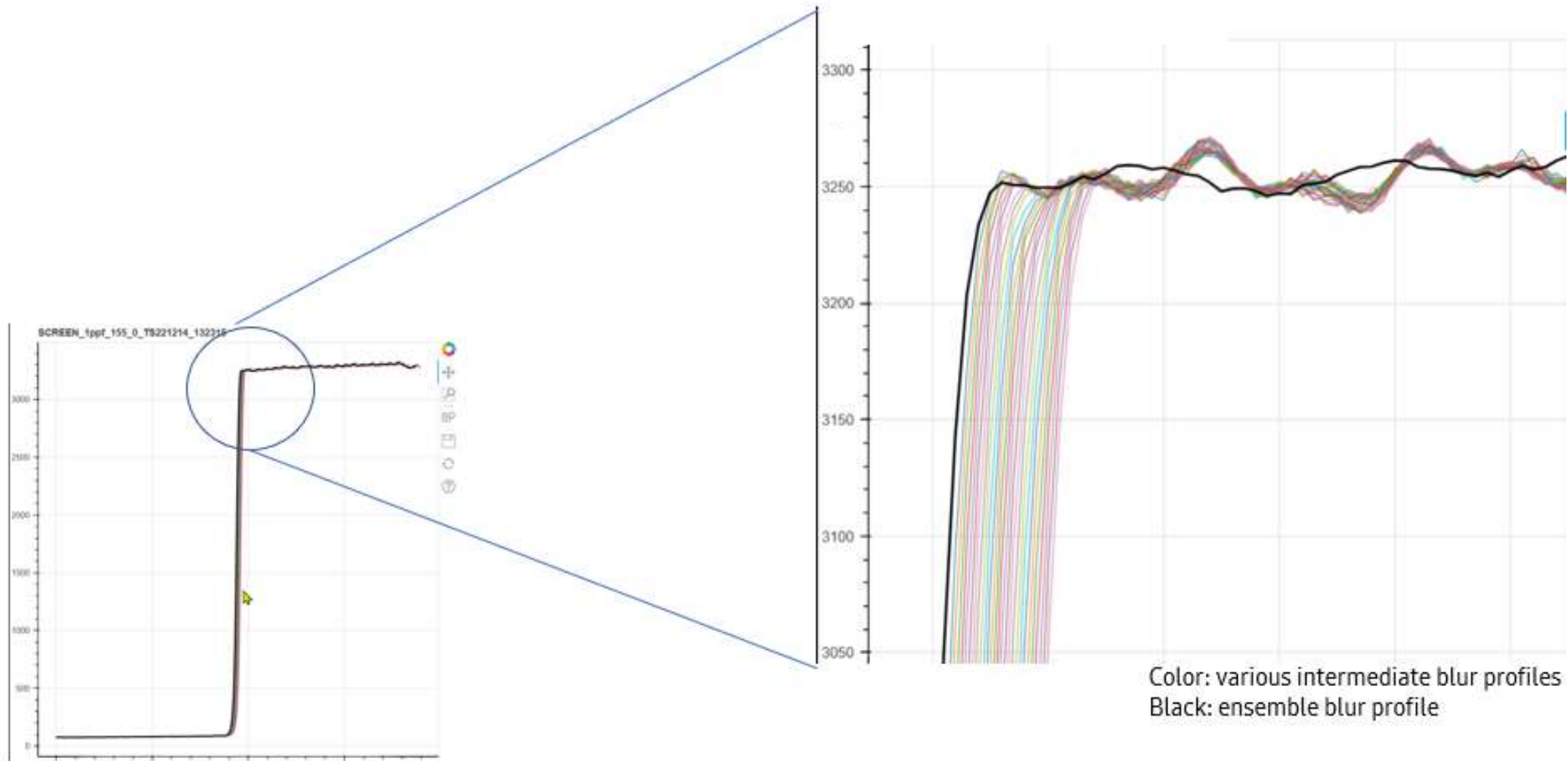
Create an ensemble of f_cnt intermediate blur profiles.



Ensemble
Blur profile (.mat)

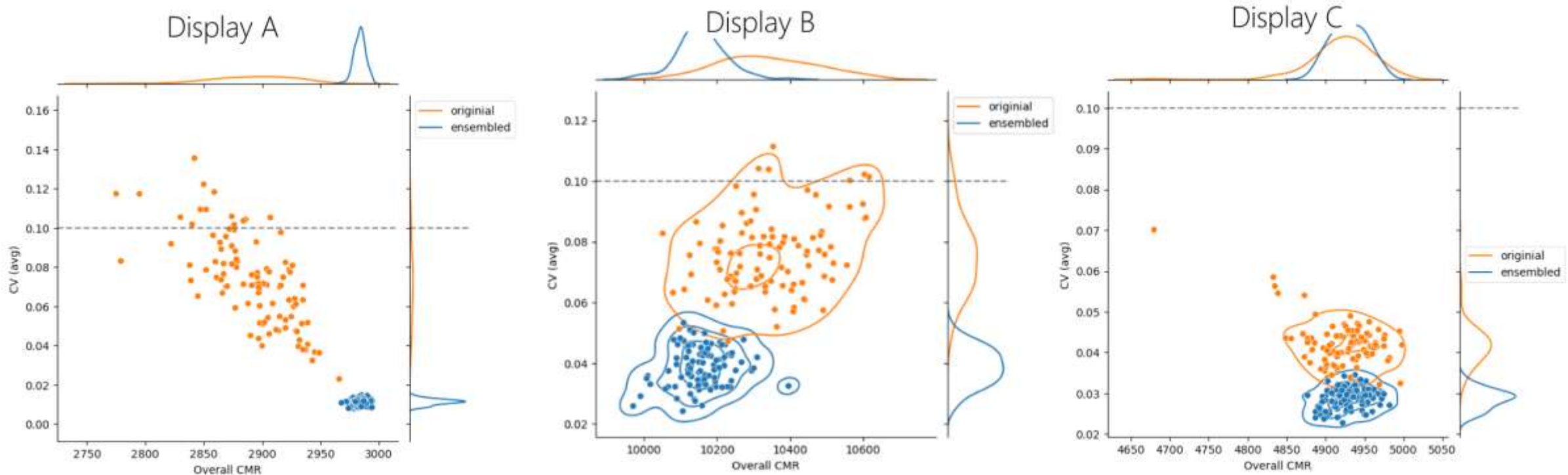
f_cnt : frame counts

Ensemble Averaging



Monte-Carlo Results

- 500 iteration of MC simulation
 - Tighten range of overall CMR values
 - Improved CV
 - Not merely an average of CMR values.
- Consistent with VESA 3rd party correlation results



Conclusion

- **ClearMR 1.1**

- Remains only certified, open, industry standard for grading motion blur in digital displays
- Contributions to improve result consistency (lowered CV)
 - Allow higher PPF to accommodate smaller / faster displays
 - Use of ensemble averaging
- Results validated by Monte-Carlo simulations & 3rd-party correlation by VESA members
- Contains other process improvements to facilitate Test Centers

Resources

- **ClearMR related articles:**
 - **Motion Ratio – Theory of Operation**, Stoltzka, iMiD 2022, Session 12
 - **Understanding ClearMR–The New Standard for Measuring Motion Blur**
<https://doi.org/10.1002/msid.1363>
 - **ClearMR 1.1—Improving the VESA Standard Method for Measuring Motion Blur**
<https://doi.org/10.1002/msid.1488>
- **VESA Compliance Testing or Membership Info:** compliance@vesa.org
- **ClearMR 1.1 FAQ & CTS:** <https://clearmr.org/faq>
- **Link to this presentation:** https://cutt.ly/imid0824_clearmr

