OPTOFIDELITY

VR / AR MULTIMETER SOLUTION

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CONTENT

- Motivation: Problem to be solved
- OptoFidelity solution

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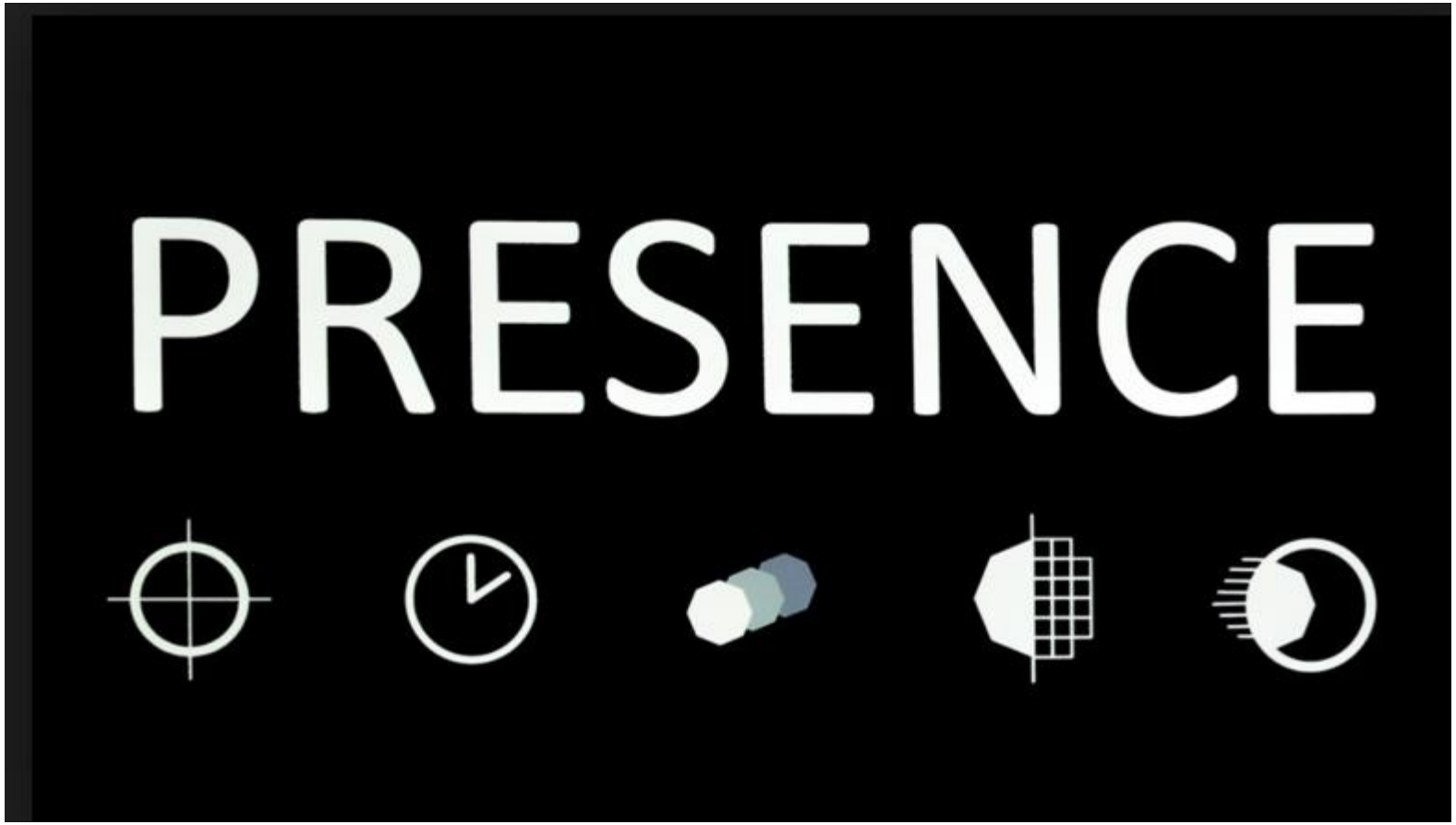
MOTIVATION

Problem to be solved

WITHOUT PRESENCE, THERE IS NO VR



http://www.roadtovr.com/oculus-shares-5-key-ingredients-for-presence-in-virtual-reality/

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TRACKING

6DOF, 360 tracking
sub-mm accuracy, no jitter noise
comfortable tracking volume

LATENCY

< 20ms motion to last photon
fuse optical tracking and IMU
minimize loop: tracker->CPU->GPU->display->photons

RESOLUTION

correct stereo
at least 1K x 1K
no visible pixel structure

PERSISTENCE

Currently less than 3ms
turn on/off quickly to avoid retinal blur
90hz+ refresh rate to avoid visible flicker

OPTICS

wide FOV: greater than 90 degrees
comfortable eyebox
high quality calibration and correction

OPTOFIDELITY’s SOLUTION

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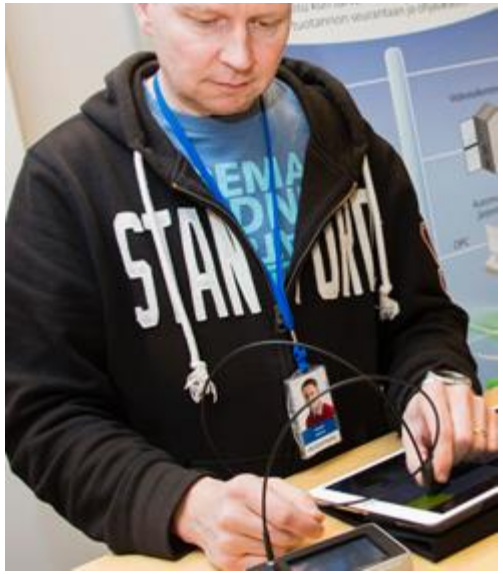
HOW WE SHALL HELP OUR VR/AR CUSTOMERS?

- Instead of complex, expensive laboratory setup, we want to offer affordable yet fully featured, futureproof measurement solution for VR Performance

Solution for every designer's table

Enables continuous QA of VR Performance

No Ph.D. degree required to use the system



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OPTOFIDELITY™ VR MULTIMETER PERFORMANCE SOLUTION OVERVIEW

- Two options for Display VR and Desktop VR
- Measures the essential factors: Motion-to-photon latency, Display persistence and LCD ghosting*

Display VR

- For display level testing
- Mobile phones or display modules

Desktop VR

- For complete HMD testing
- Tethered or Untethered headsets

* Q2/2017

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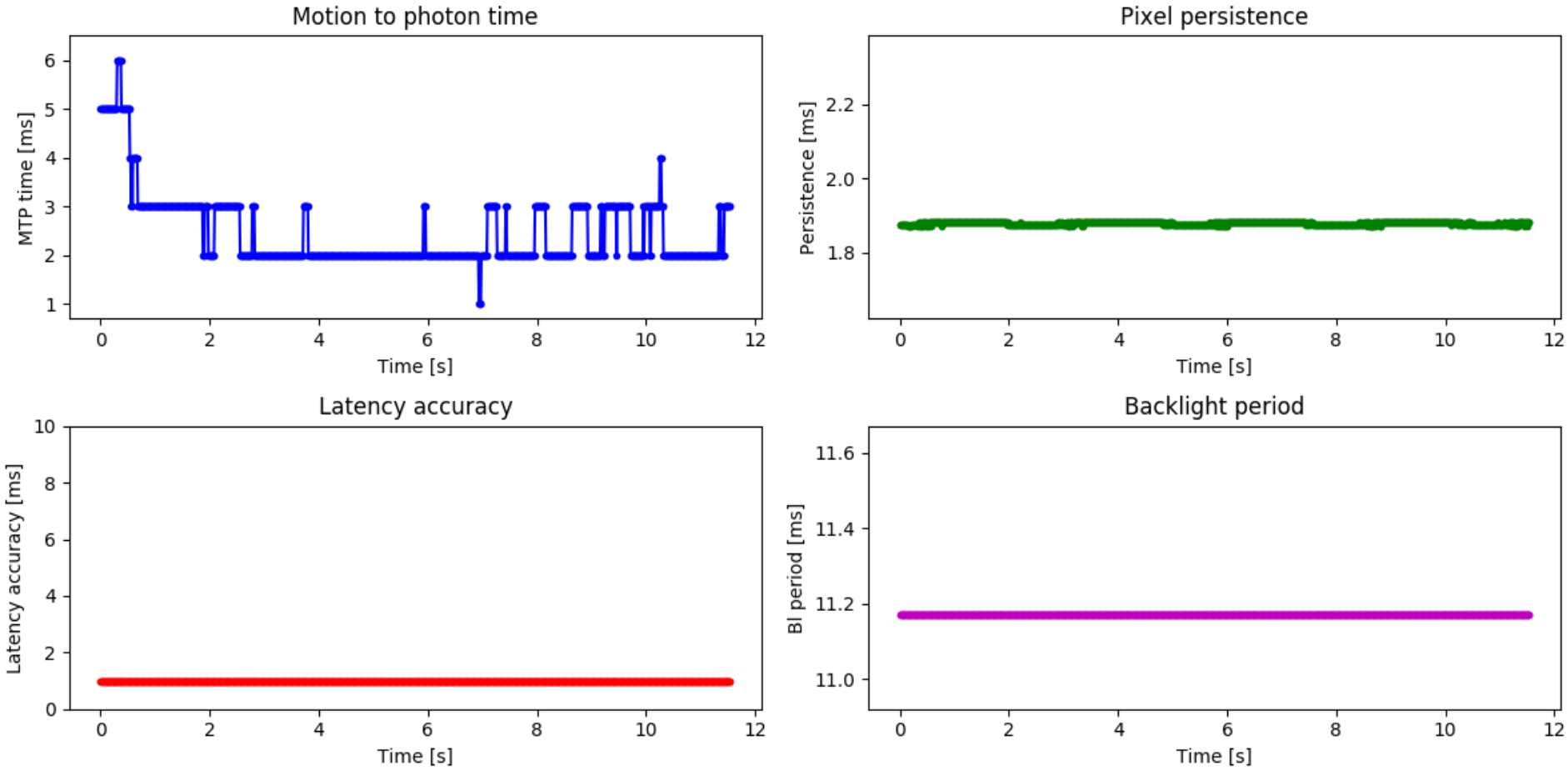
OPTOFIDELITY™ VR MULTIMETER RESULTS GRAPHS



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OPTOFIDELITY™ VR MULTIMETER PERFORMANCE SOLUTION

- OptoFidelity VR Multimeter solution offers:
  - Futureproof with firmware updates and upgradeable sensor modules
  - Patented technology to adapt any display type
  - 100% test automation supported with API
- Test content available in various formats
  - Android application
  - Test image
  - Backlog: Unity application, 360 panoramic photos / videos
- See next slides for VR performance system factors and specs

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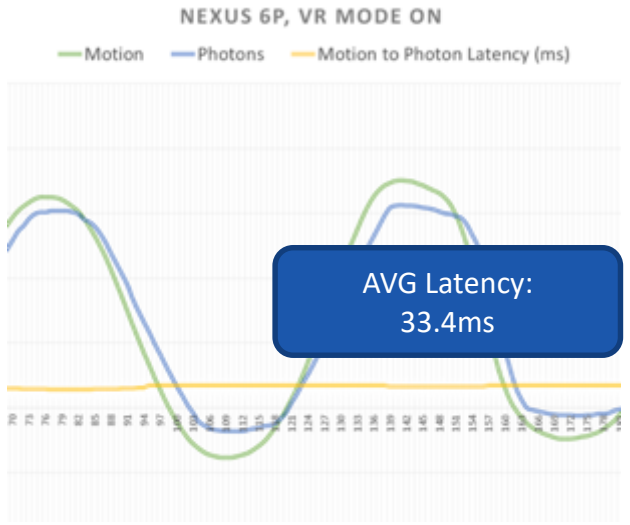
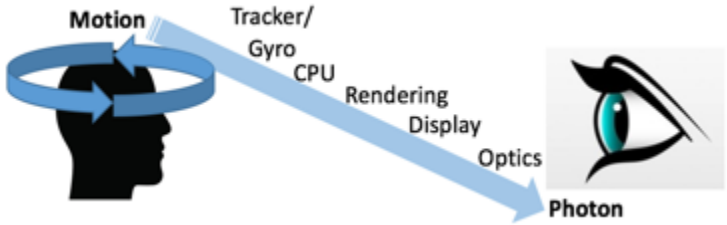
MOTION-TO-PHOTON LATENCY

- Motion-to-Photon latency is the time (ms) needed for a head mounted display (HMD) movement to be fully perceived on the VR display. Typically the latency should be below 20ms
- **Application-to-Photon** latency is often used as a measurement method. However, being an intrusive method, it misses very important aspect – the delay caused by tracker/gyroscope. First of all, gyroscope may not register HMD movements in real-time, and there might be also issues in communication between the tracker/gyroscope and VR application.
- Poor Motion-to-Photon Latency is the most usual reason for motion sickness and user's nausea.
- OptoFidelity Video Multimeter VR measures the true, end-user perceived Motion-to-Photon latency by exploiting accurate reference measurements of the HMD movements.





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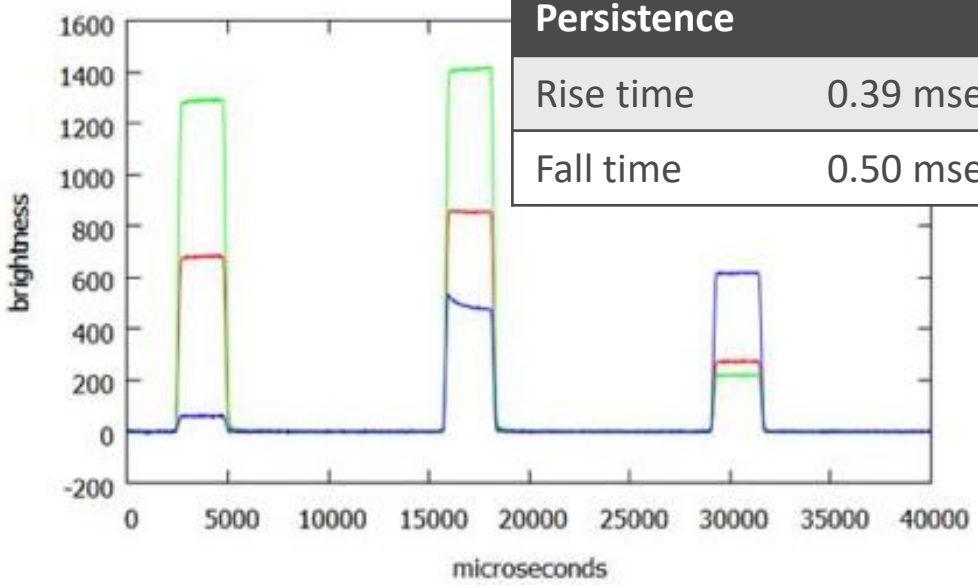
PIXEL PERSISTENCE AND REFRESH RATE

- Pixel Persistence is the time that the display uses to show the content pixels
- PP msec = Duty cycle % / Content fps * 10
- The PP value should be within specific time frame, because too long PP causes motion blur, while too short PP may affect the brightness and contrast of the viewed video
- Along with low Persistence, too low Refresh rate affects the user experience and can cause headache
- OptoFidelity Video Multimeter xR measures the true, end-user perceived Pixel Persistence and content Refresh rate (see the separate slides about Jerkiness and Jitter)

Pixel Persistence	1.97 msec
Rise time	0.39 msec
Fall time	0.50 msec



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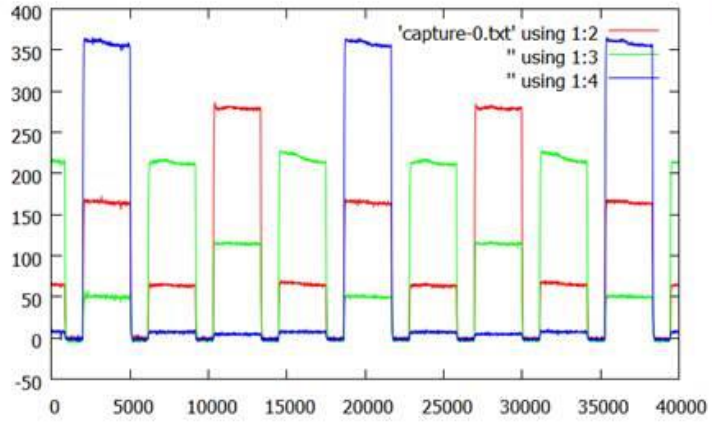
LCD GHOSTING (Q2/2017)

- Video Multimeter is capable of measuring the MPRT factors, which typically have required complex and expensive Pursuit or TDI cameras
- LCD Ghosting artifacts can be divided onto three main types:
  - Asymmetric pixel transitions (ghosting, trailing motion artifact)
  - Response time acceleration (coronas, pixel overshoot)
  - PWM artifacts (repeated images, motion fluidity issues)

AR CAPABILITY(Q2/2017)

- Video Multimeter is capable of capturing the sequential frame information from devices like Hololens
- Capability to provide the M2P and Pixel Persistence of sequential frame projectors shall be added



Full color frame 1

Full color frame 2

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MEASUREMENT SPECS*

- Primary probing frequency: 100 kHz
- Persistence Accuracy: +/- 0.05ms
- MP2 Accuracy: +/-1 ms
- Max synchronized framerate: 120fps
- 1DOF, more DOF on request

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THANK YOU