

Visualization for *AR* & *Surgical Robotics*

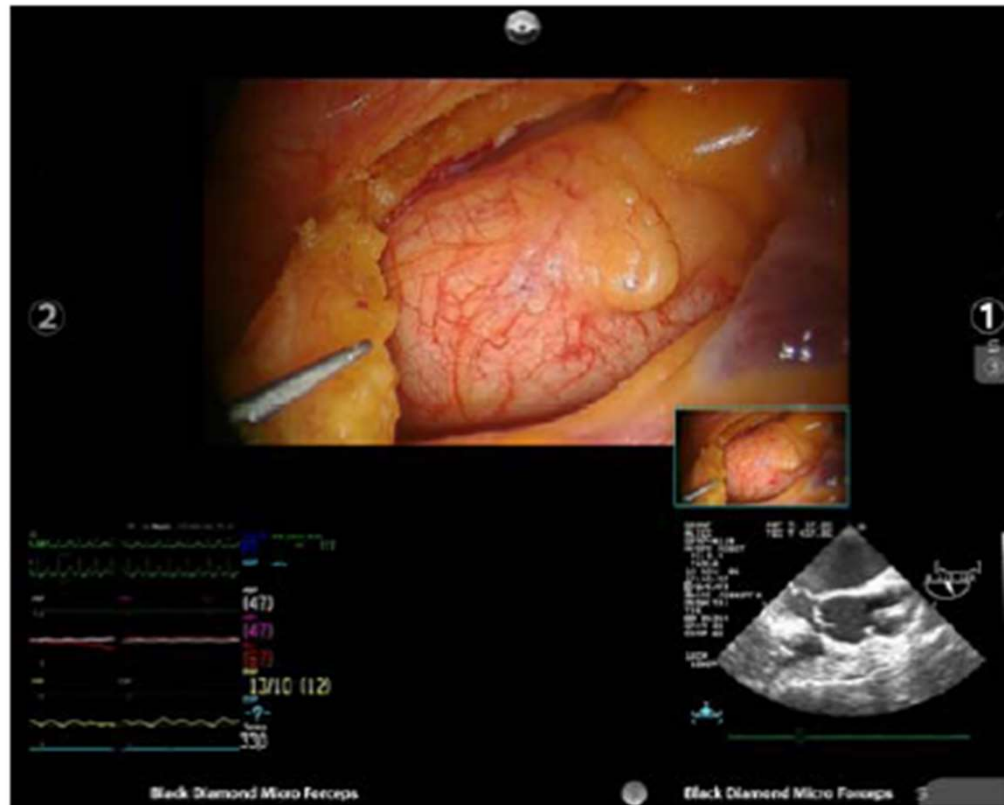
- Visual Clarity & Imaging & Human Physiology



Wenyi Zhao
2020



Visualization in Practice: Important Info for Human Eyes



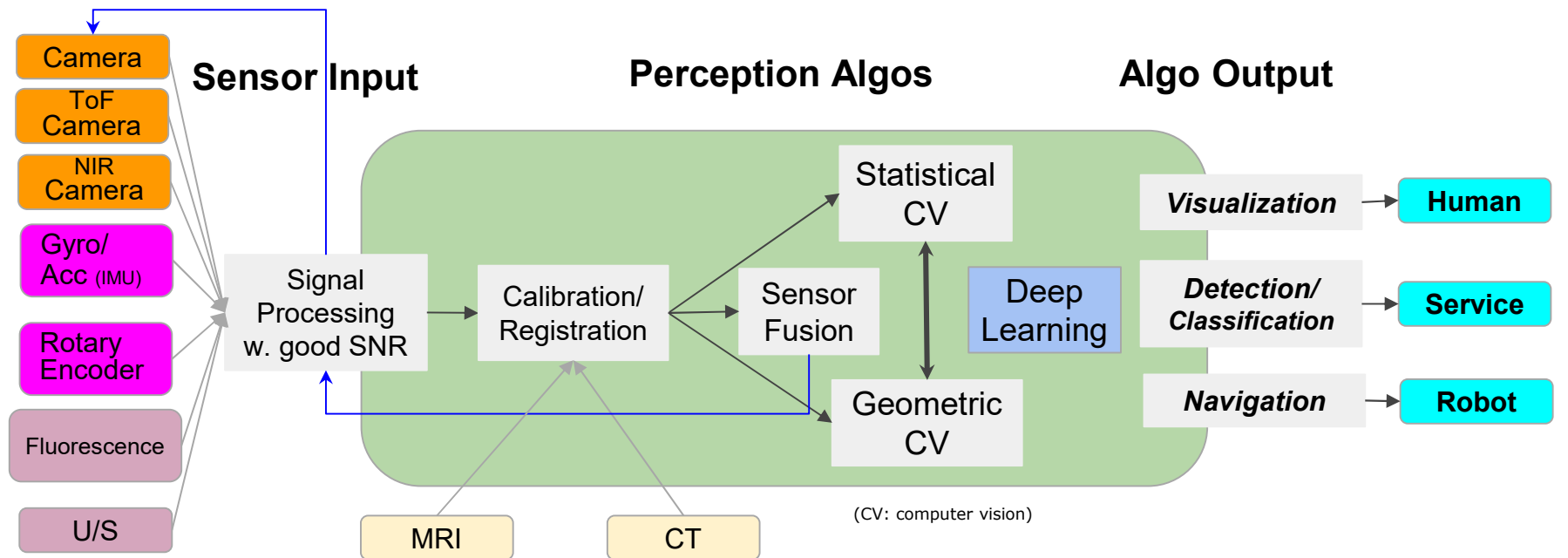
Visualization: Three Topics for Today

visualization noun

2. the act or process of interpreting in **visual terms** or of putting into **visible form**

Basic Visualization → Beyond Human Vision → Presentation to eyes		
Visual Clarity	Imaging the Unseen	Display To Human
<i>Create images that reveal important features</i>	<i>Convert invisible info into visible images</i>	<i>Create visual presentation fitting human eyes</i>
<ul style="list-style-type: none">• Visualization Pipeline• Image Super-resolution• Computational surgical imaging	<ul style="list-style-type: none">• ICG imaging• Tissue-specific Fluorescence imaging• MRI scan• Ultrasound• CT scan• Photo-acoustic imaging• Narrow band imaging	<ul style="list-style-type: none">• Stereoscopic/3D Display• Eye Tracking for Near-Eye display• Low latency rendering

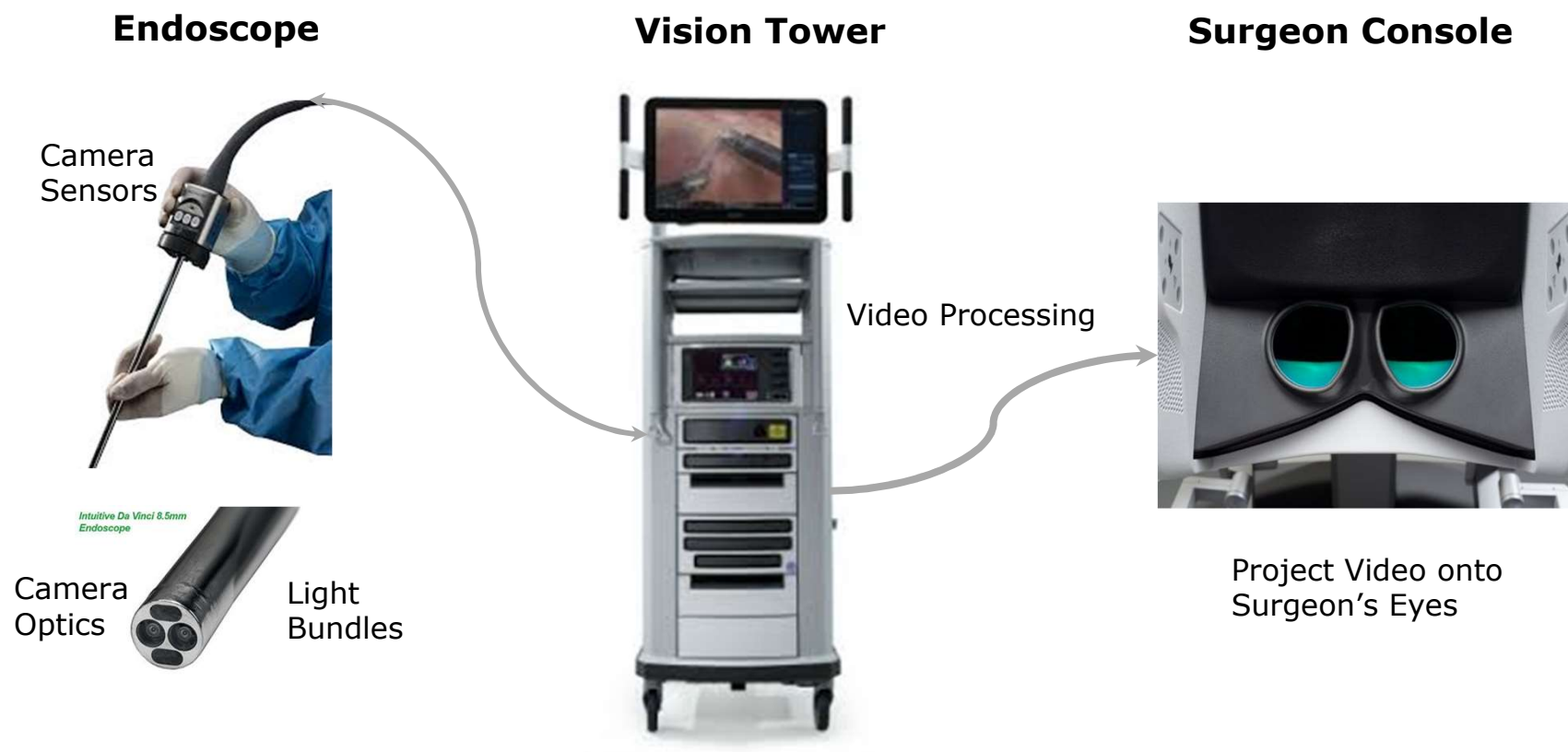
Machine Perception (AI): Wenyi's Systems Perspective



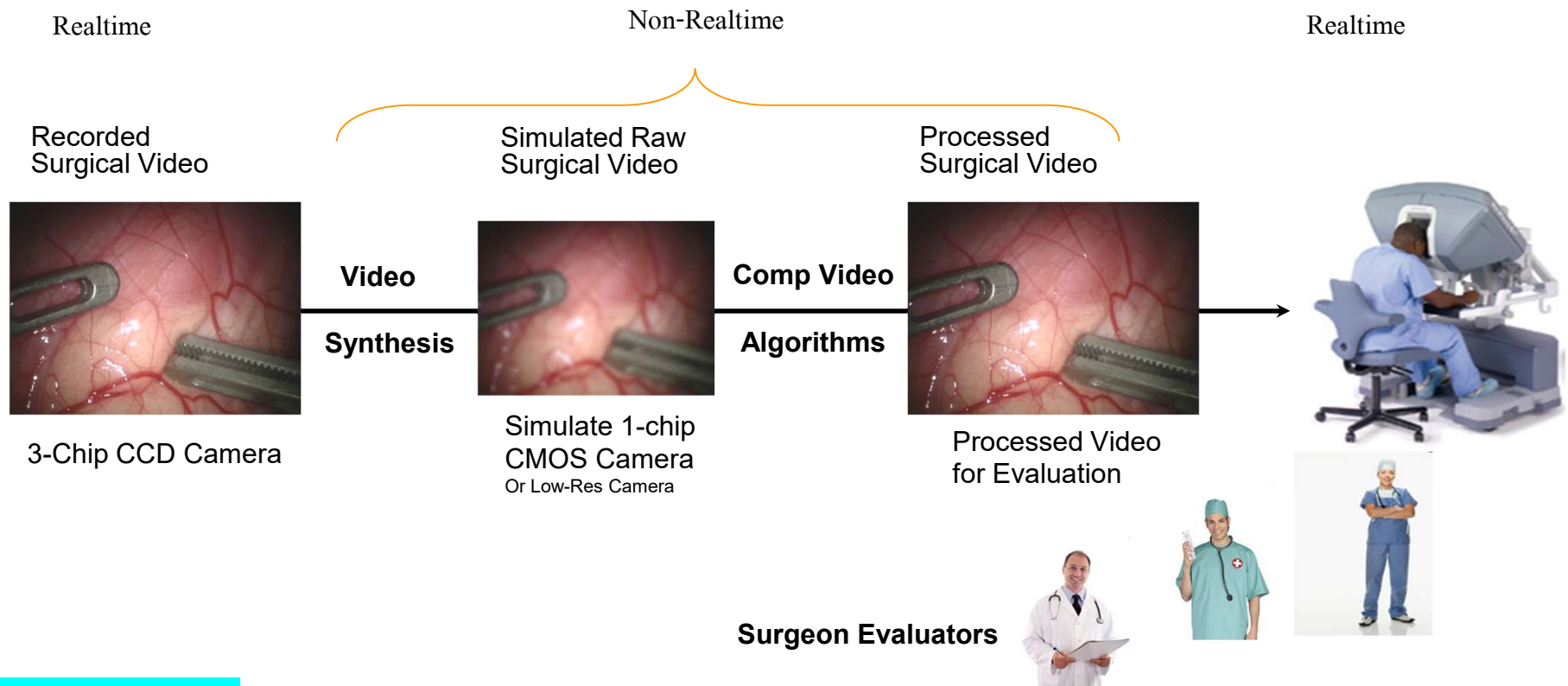
Product Development Cycle (Systems Perspective)



Visualization Pipeline: Building Blocks

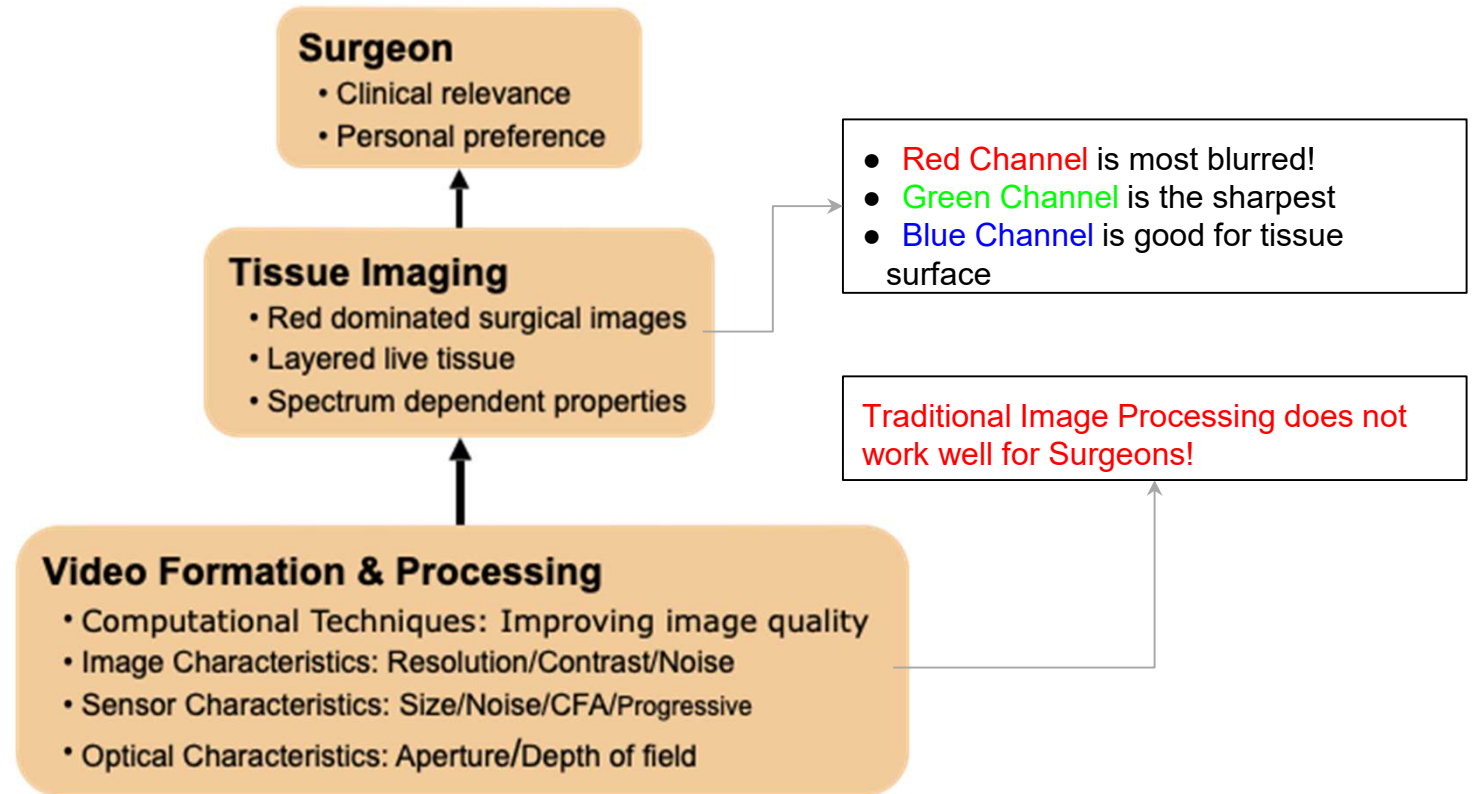


Simulation from Real data to Predicate Performance



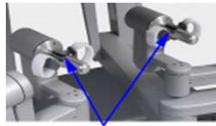
daVinci: 2008-2009

Computational Surgical Imaging for Surgeons



Fluorescence/ICG Imaging on daVinci

Activate Fluorescence Imaging Mode



Normal (white light)



Fluorescence Mode
(Near Infrared)

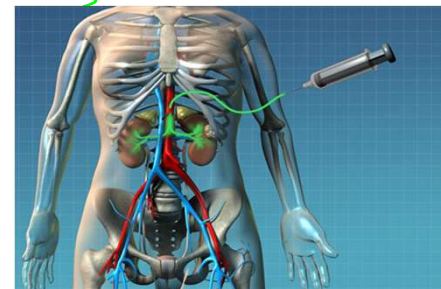
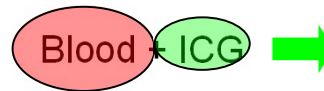
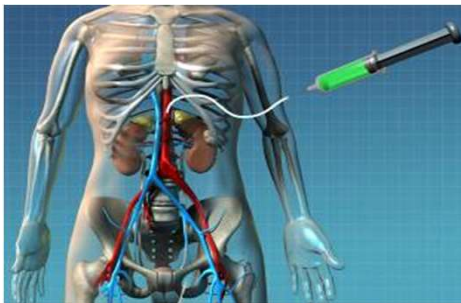


Laser on new illuminator is activated



Laser Excites IC-Green and Fluoresces

Inject IC-Green into Bloodstream



Dr Nguyen@UCSD: Color Coded Surgery

Tissue-Specific Fluorescence Imaging

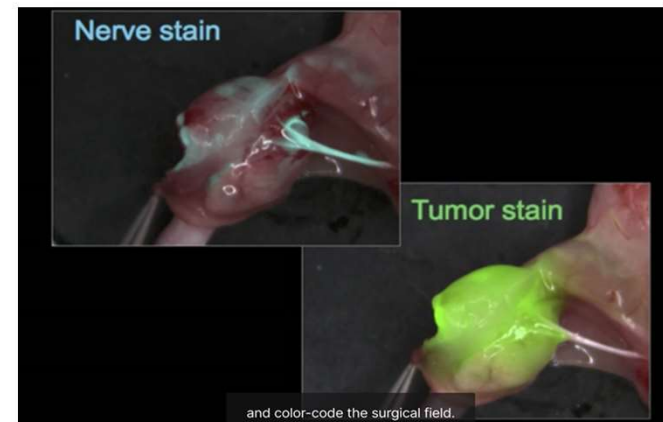
Enhancing Visualization to Enable Precision Surgery™

1. Delineate Tumor Margins

2. Preserve Nerves

3. Multispectral integration

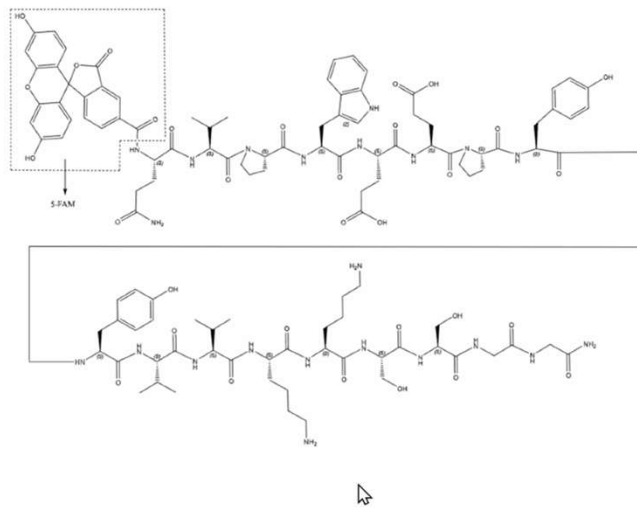
- tumors + nerves
- agents + devices + digital processing



Dr Nguyen@UCSD: Color Coded Surgery

Solution: ALM-488

a peptide-dye conjugate with affinity for nerves



17aa peptide-FAM

- Fluorescent illumination of nerves in surgical field
- Identified via Phage display against human nerves
- Does not cross BBB
- No biological effect on binding
- Co-Developed w Dr. Roger Tsien (2008 Nobel Laureate)



Why 3D Display for AR and Surgical Robotics?

To mimic the real 3D world, you create 3D display

- For AR, it is about display virtual contents as if they were real!
- For surgical robotics, 3D vision is the key advantage of robotic surgery over laparoscopic surgery

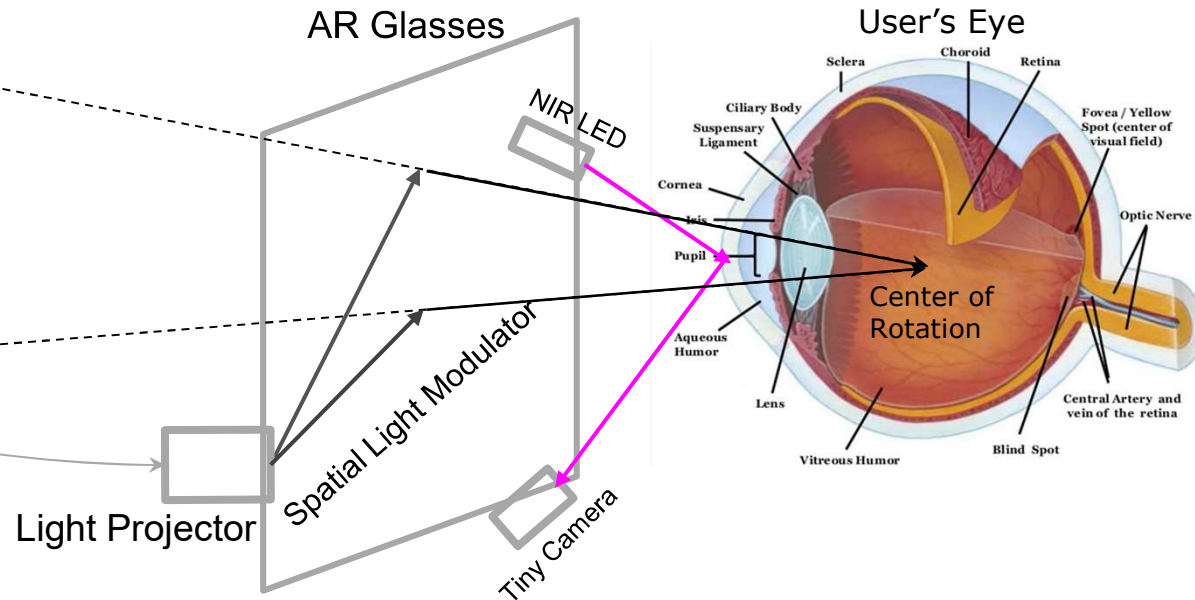


Eye Tracking For Near-Eye Display

Content Rendering Engine



AR Glasses



ET Outputs Required

- Center of Rotation/IPD (interpupillary distance) -> Rendering Center
- Vergence -> Virtual Object Depth
- Gaze -> Interaction Applications