



**Al-Mustaqbal University**  
**College of Sciences**  
**Intelligent Medical System Department**



جامعة المستقبل  
AL MUSTAQBAL UNIVERSITY

كلية العلوم  
قسم الانظمة الطبية الذكية

## Lecture: (7)

**Case Studies and Industry Insights for  
Medical Multimedia**

**Subject: Medical Multimedia**

**Class: Fourth**

**Lecturer: Dr. Maytham N. Meqdad**



## Case Studies and Industry Insights for Medical Multimedia

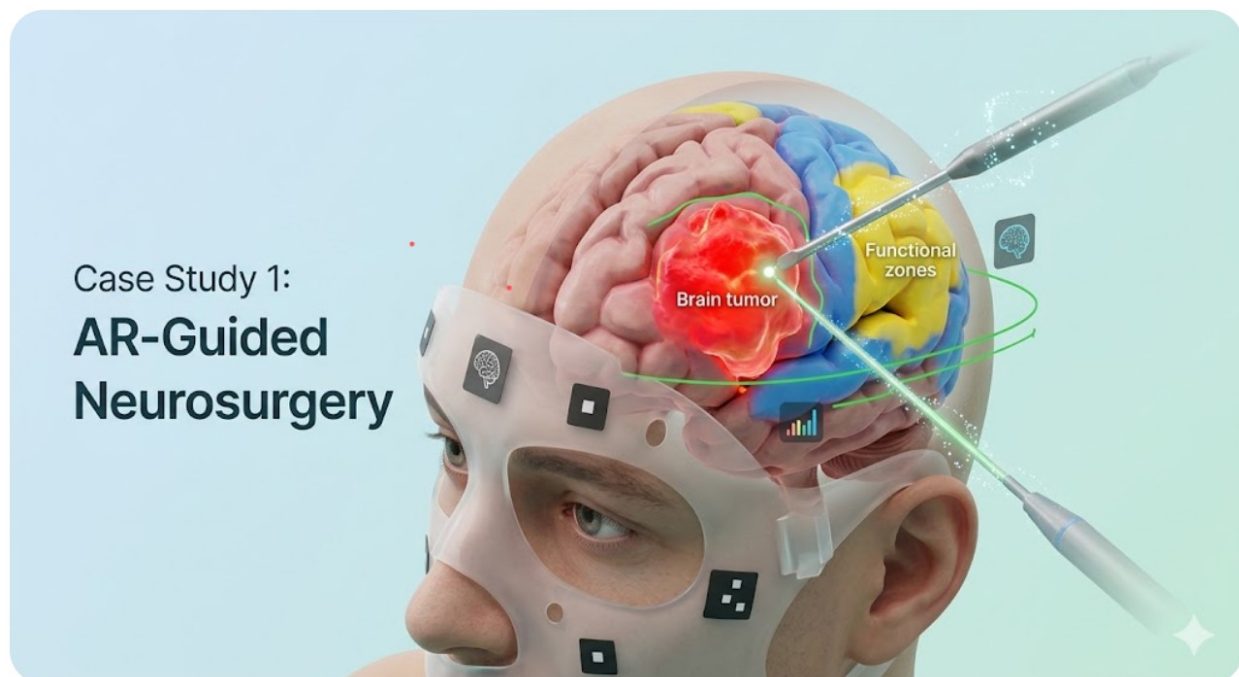
### 1. Introduction: Beyond the Pixels

In the context of intelligent Medical Systems, **Medical Multimedia** is no longer just about viewing images or videos. It is about **Actionable Visual Data**. The industry is shifting from "Image Storage" to "Intelligent Perception," where multimedia streams are integrated with AI to provide real-time diagnostic support.

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### 2. Part I: Real-World Case Studies

#### Case Study A: AR-Guided Precision Neurosurgery

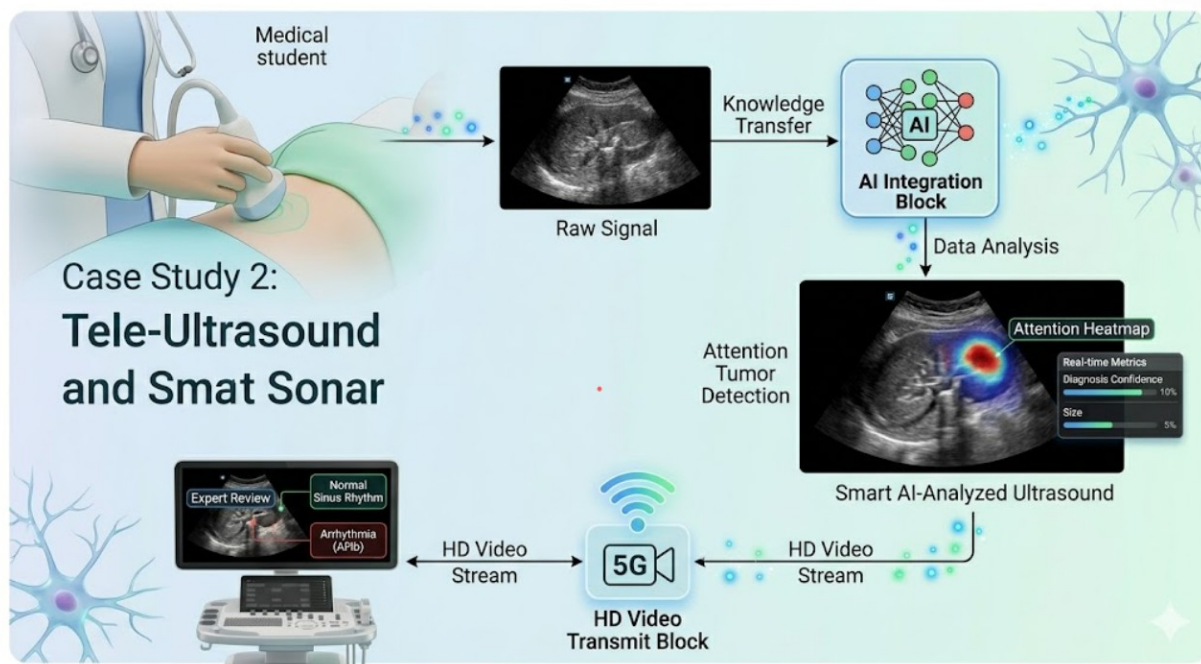


- **The Scenario:** A surgical team needs to resect a deep-seated brain tumor while avoiding critical functional zones.



- **The Multimedia Solution:** Integrating pre-operative **3D MRI/CT volumes** with the surgeon's live view using **Augmented Reality (AR)** headsets.
- **Key Challenge: Image Registration & Latency.** The virtual 3D model must align perfectly with the physical patient (<1mm error) in real-time.
- **Industry Outcome:** Companies like *Medtronic* and *Brainlab* have reduced surgical complications by **25-30%** using these spatial multimedia systems.

### Case Study B: Tele-Ultrasound via 5G and AI



- **The Scenario:** An emergency technician in a remote area performs an ultrasound while a specialist guides them from a city hospital.
- **The Multimedia Solution:** High-definition (HD) video streaming combined with **AI-Overlay**.
- **Technical Insight:** Using **Region-of-Interest (ROI)** coding. The system prioritizes high-bitrate for the organ being scanned while compressing the background to save bandwidth.
- **Result:** Real-time expert diagnosis in rural areas, saving critical "Golden Hour" time for trauma patients.



### **3. Part II: Industry Insights (The 2026 Landscape)**

The medical technology (MedTech) industry is currently driven by three major pillars:

#### **I. Edge AI & On-Device Processing**

- **Insight:** Giants like **NVIDIA (Clara Platform)** and **GE Healthcare** are moving away from Cloud processing for multimedia.
- **Why?** Privacy (GDPR/HIPAA) and Speed. Modern ultrasound probes now have "built-in" AI chips that perform image enhancement and measurement locally on the device (The Edge).

#### **II. The Rise of the "Medical Digital Twin"**

- **Insight:** Industry is moving toward creating a 4D (3D + Time) multimedia replica of a patient's organ.
- **Application:** Surgeons "practice" on a digital heart or brain before the actual surgery. This involves complex fluid dynamics visualization and biomechanical modeling.

#### **III. Standardizing "AI-Ready" Multimedia**

- **Insight:** DICOM (Digital Imaging and Communications in Medicine) is evolving. The industry now demands **Metadata-Rich Multimedia**.
  - **Shift:** We don't just save an image; we save the "AI Inference" layers alongside it, allowing different smart systems to talk to each other (Interoperability).
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#### **4. Part III: Engineering Challenges in the Field**

When you graduate and enter the industry, you will face these "Real-World" hurdles:

- **Explainable Visuals (XAI):** Doctors reject "Black Box" AI. Your multimedia system must highlight *why* the AI flagged a region (e.g., using Saliency Maps).
  - **Cyber-Physical Security:** Medical images are high-value targets. The industry is currently investing heavily in **Blockchain for Medical Media** to ensure data integrity and traceability.
  - **Lossless vs. Lossy Dilemma:** In the industry, a "Lossy" compression that artifacts a tiny lesion is a legal and medical nightmare. Engineering the perfect balance is key.
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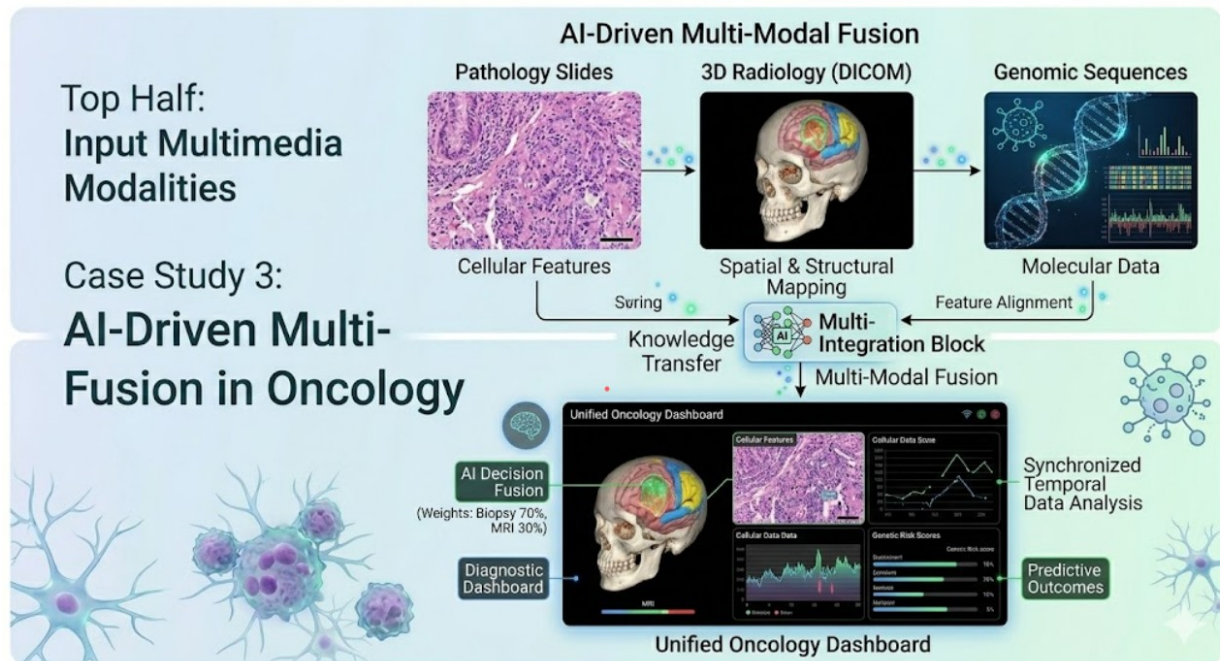
#### **5. Interactive Workshop: The "Smart Ambulance" Challenge**

**Task for Students:** Imagine you are the Lead Engineer for a Smart Ambulance startup. You need to stream a live **Multi-Modal Feed** (Video of the patient + ECG Waveforms + Ultrasound) to the hospital.

1. **Optimization:** How do you handle a sudden drop in 5G signal? (Hint: Scalable Video Coding - SVC).
  2. **User Experience:** How do you display this data on the doctor's tablet without "Information Overload"?
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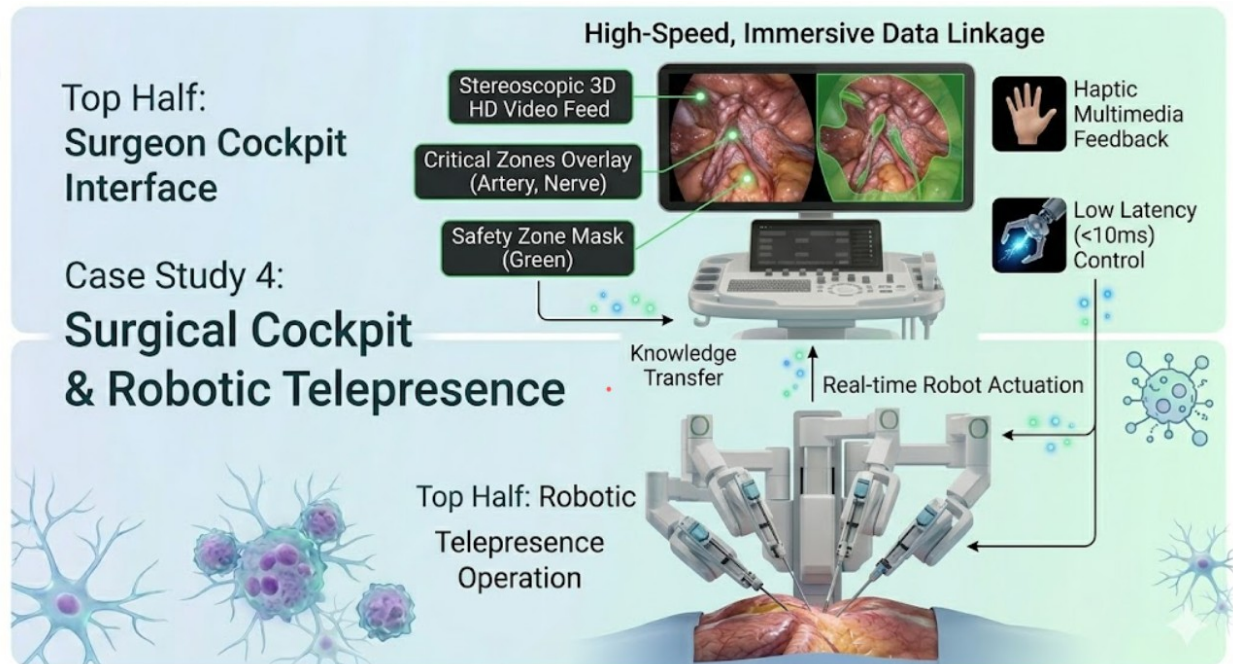
### Case Study 3: AI-Driven Multi-Modal Fusion in Oncology (IBM Watson & Memorial Sloan Kettering)



- **The Problem:** Oncology (Cancer) diagnosis requires analyzing huge volumes of fragmented multimedia: Pathological slides (Images), Radiology (DICOM), and Genomic sequences (Data).
- **The Industry Insight:** The shift from "Single-Source" to **Multi-Modal Fusion**. Industry leaders are developing platforms that "fuse" these different multimedia types into a single diagnostic dashboard.
- **Technical Implementation:**
  - **Feature Alignment:** Mapping pixels from a PET scan to a CT scan to locate metabolic activity in anatomy.
  - **Decision Fusion:** Using Deep Learning to assign "Weights" to each media type (e.g., trust the biopsy image 70% and the MRI 30%).
- **Student Discussion:** How do you synchronize temporal data (changes over time) with static images in a smart oncology system?



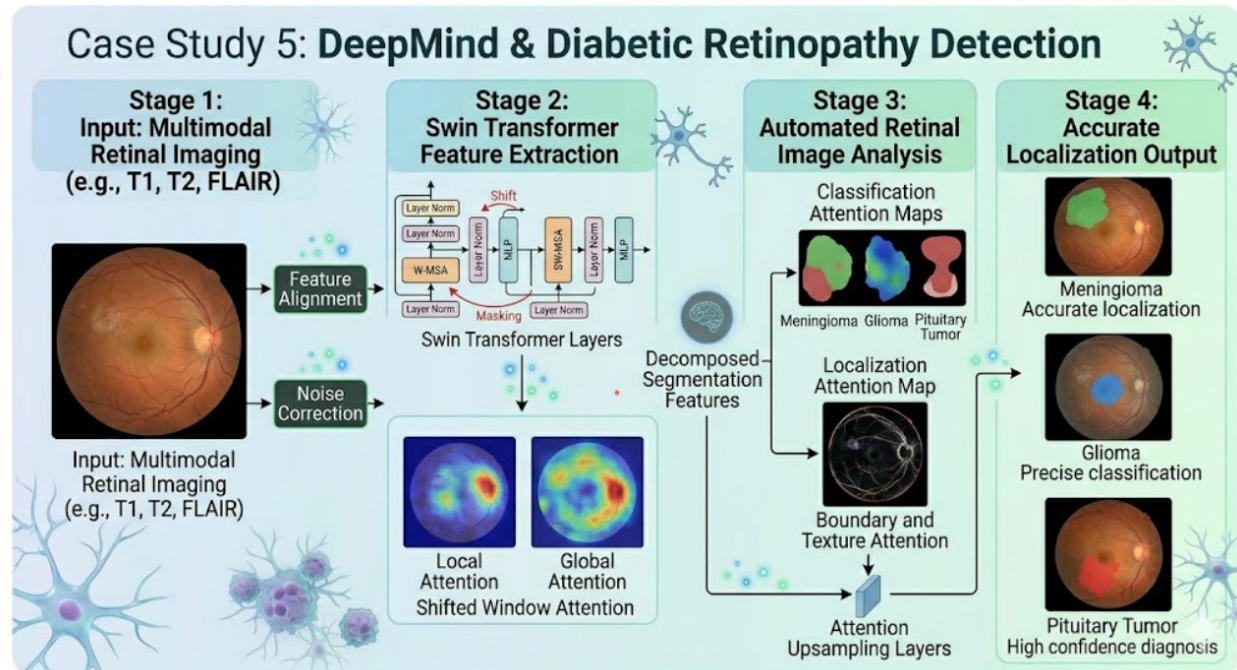
## Case Study 4: The "Surgical Cockpit" & Robotic Telepresence (Intuitive Surgical - Da Vinci System)



- **The Problem:** Surgeons operating via robots need "Immersive Feedback" that mimics human vision and touch.
- **The Multimedia Solution: Stereoscopic 3D HD Video Streams.**
- **Technical Details:**
  - **Low Latency Encoding:** The video must travel from the robot's camera to the surgeon's console in less than **10ms**. Anything higher causes "Surgical Motion Sickness."
  - **Video Overlay:** Real-time overlay of "Safety Zones" (No-Go areas) to prevent the robot from hitting a major artery.
- **Industry Insight:** Companies are now adding **Haptic Multimedia** (Force feedback), where the data isn't just visual but tactile.



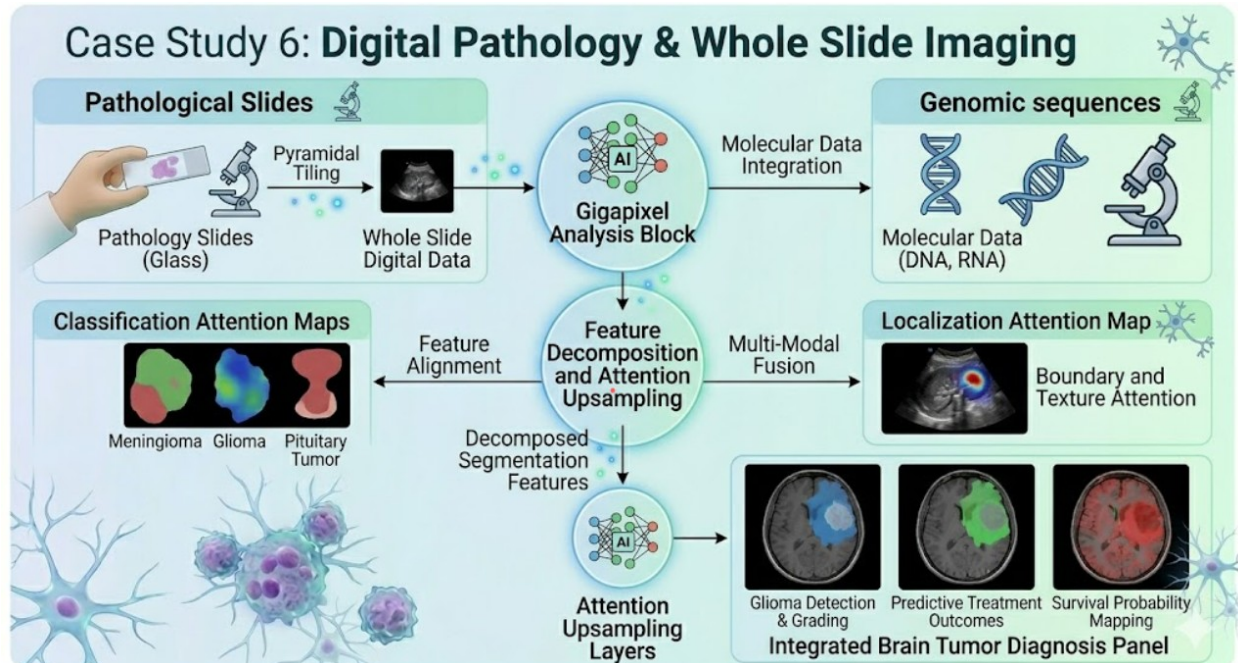
## Case Study 5: DeepMind (Google Health) & Diabetic Retinopathy Detection



- **The Problem:** Millions of diabetic patients need annual eye scans, but there aren't enough ophthalmologists to read the images.
- **The Multimedia Innovation: Automated Retinal Image Analysis.**
- **Technical Breakdown:**
  - **Preprocessing:** Normalizing lighting and contrast in retinal photos across different camera brands (Interoperability).
  - **Segmentation:** Automatically detecting "Microaneurysms" (tiny red dots) that are only a few pixels wide.
- **Industry Impact:** This is a prime example of **Screening Automation**. The system acts as a "Triage" tool, flagging only the high-risk images for human review.



## Case Study 6: Digital Pathology & "Whole Slide Imaging" (Philips IntelliSite)



- **The Problem:** Traditional pathology uses glass slides and microscopes. These cannot be shared easily or analyzed by AI.
- **The Engineering Challenge: Gigapixel Imaging.** A single pathology slide can be **10 GB** in size (e.g., 100,000×100,000 pixels).
- **Multimedia Solution:**
  - **Pyramidal Tiling:** Breaking the massive image into small tiles and levels of zoom (similar to Google Maps).
  - **Streaming Protocols:** Only loading the tiles the doctor is currently looking at to save RAM and Network bandwidth.
- **Smart System Insight:** Digital pathology enables "Computational Pathology," where AI counts cells or identifies cancerous patterns across the entire gigapixel canvas.



## References

- [1] J. Pottle, “Virtual reality and the transformation of medical education,” *Future Healthcare Journal*, vol. 6, no. 3, pp. 181–185, 2019.
- [2] H. Kang, J. Lee, and S. Kim, “Applications of multimedia technology in medical education,” *Journal of Educational Technology & Society*, vol. 23, no. 2, pp. 1–14, 2020.
- [3] C. Moro, Z. Štromberga, A. Raikos, and A. Stirling, “The effectiveness of virtual and augmented reality in medical education: A meta-analysis,” *Medical Education*, vol. 55, no. 3, pp. 293–305, 2021.
- [4] P. Ruisoto and J. A. Juanes, “3D visualization and anatomical understanding in medical education,” *Anatomical Sciences Education*, vol. 13, no. 4, pp. 494–502, 2020.
- [5] L. Zhang, Y. Zhou, and H. Liu, “Three-dimensional visualization techniques in anatomy education: A systematic review,” *BMC Medical Education*, vol. 22, p. 512, 2022.
- [6] B. Preim and S. Saalfeld, “A survey of virtual human anatomy education systems,” *IEEE Computer Graphics and Applications*, vol. 38, no. 1, pp. 28–43, 2018.
- [7] J. Radianti, T. A. Majchrzak, J. Fromm, and I. Wohlgenannt, “A systematic review of immersive virtual reality applications for higher education,” *Education and Information Technologies*, vol. 25, pp. 287–315, 2020.
- [8] A. Bernardo, “Virtual reality and simulation in neurosurgical training,” *World Neurosurgery*, vol. 145, pp. 537–544, 2021.
- [9] F. Bork et al., “Augmented reality in medical training and education,” *IEEE Computer Graphics and Applications*, vol. 42, no. 1, pp. 12–21, 2022.
- [10] R. R. Shamir et al., “Visualization and analysis of medical imaging data,” *Nature Biomedical Engineering*, vol. 3, pp. 566–576, 2019.
- [11] D. Mitsouras et al., “Medical 3D printing for the radiologist,” *Radiographics*, vol. 40, no. 4, pp. 987–1002, 2020.
- [12] S. Jansen, M. Klein, and T. Schultz, “Open-source tools for medical visualization and simulation,” *Computer Methods and Programs in Biomedicine*, vol. 208, p. 106262, 2021.
- [13] J. Bennett and T. Checkel, “Blender for scientific and medical visualization,” *Journal of Open Source Software*, vol. 5, no. 47, p. 2158, 2020.