Spring 2015,CIS II Project #4

RGBD Camera Integration into Camera Augmented Mobile C-arm (CamC)

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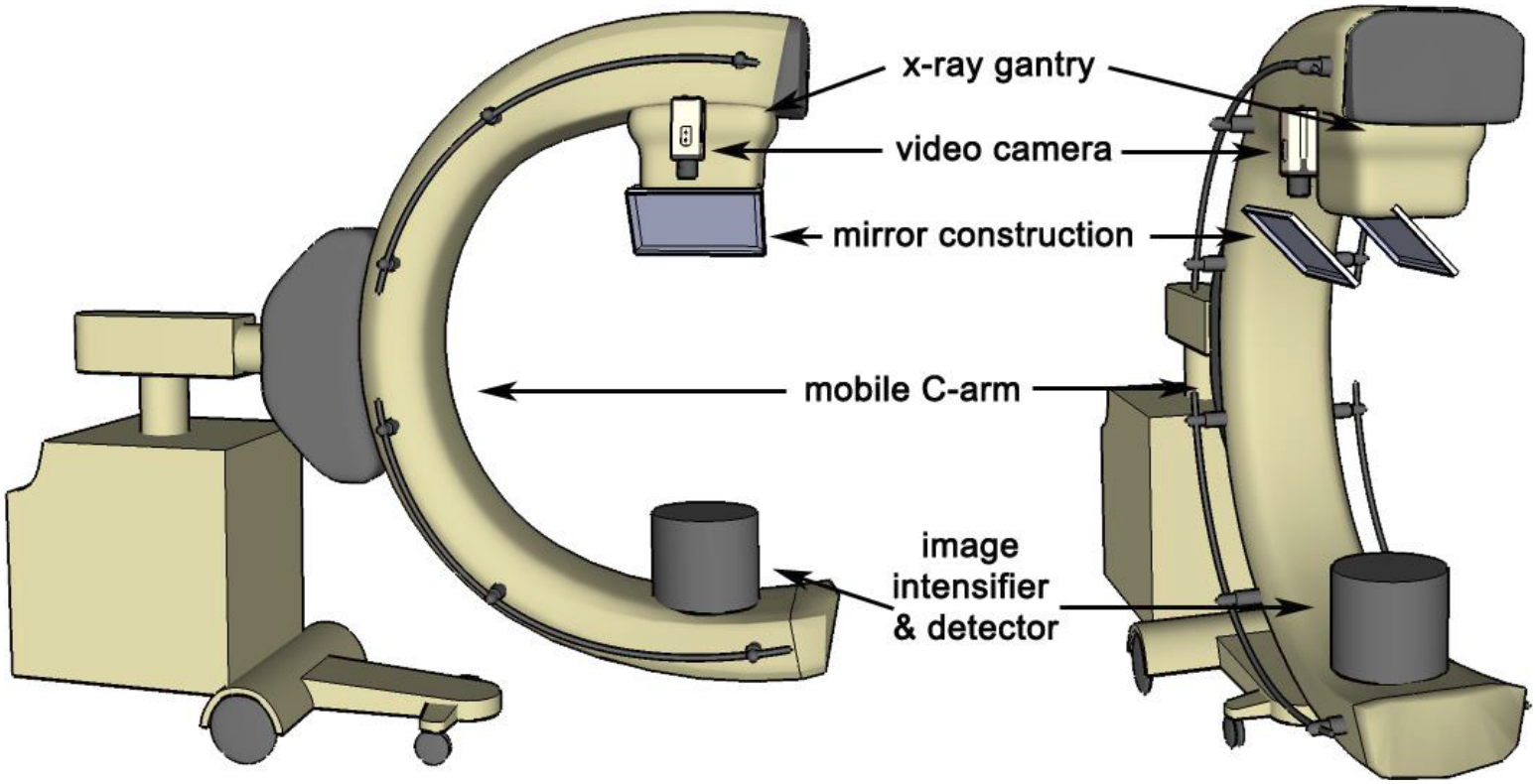
JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

1. Project Goal

- Integrate an RGBD sensor in the current Camera Augmented Mobile C-arm (CamC) framework, and having it calibrated with the current setup.

- Enhance the view of CamC, and pave the way for further integrations of depth data.

2. CamC Technology (Prior Works)



Navab, Nassir, S-M. Heining, and Joerg Traub. "Camera augmented mobile C-arm (CAMC): calibration, accuracy study, and clinical applications." Medical Imaging, IEEE Transactions on 29.7 (2010): 1412-1423.

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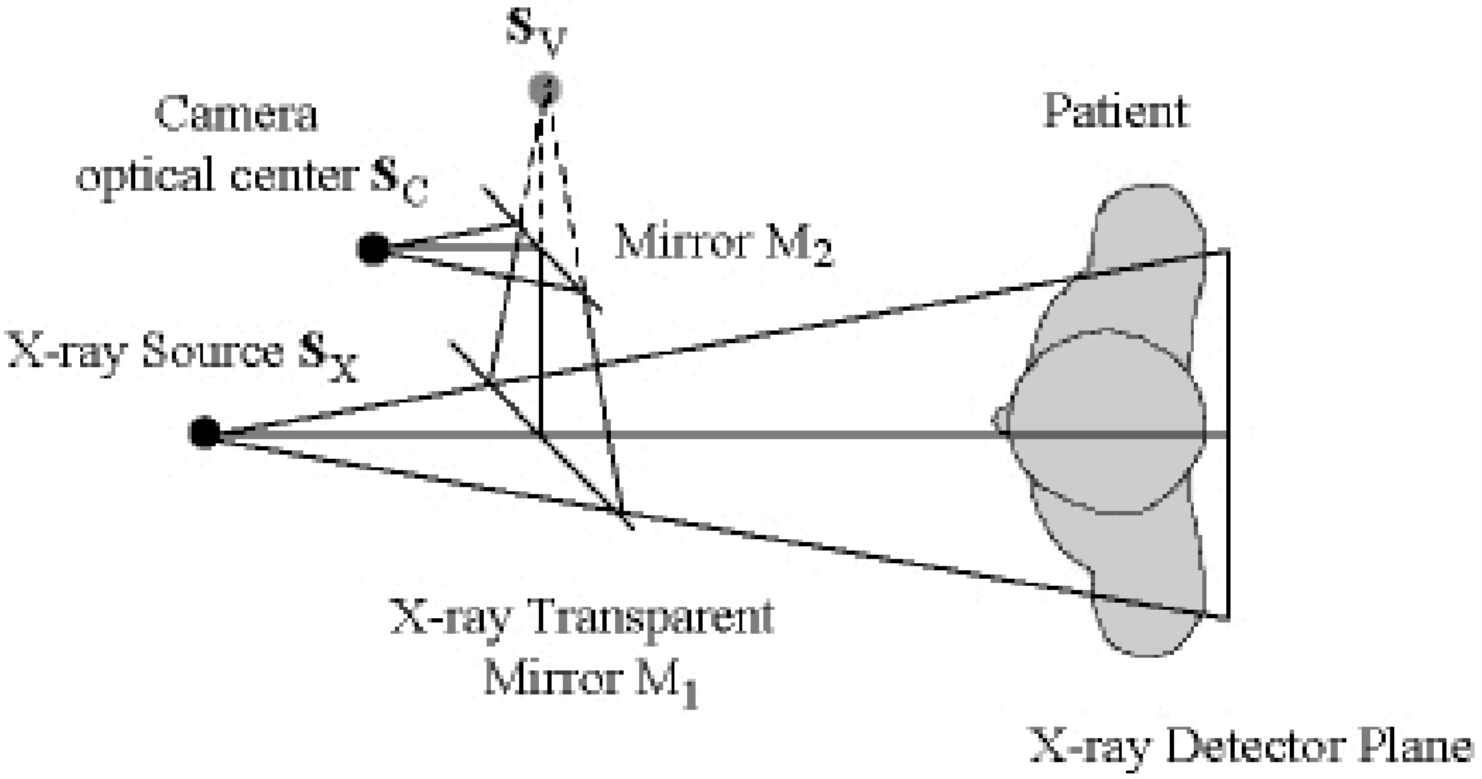
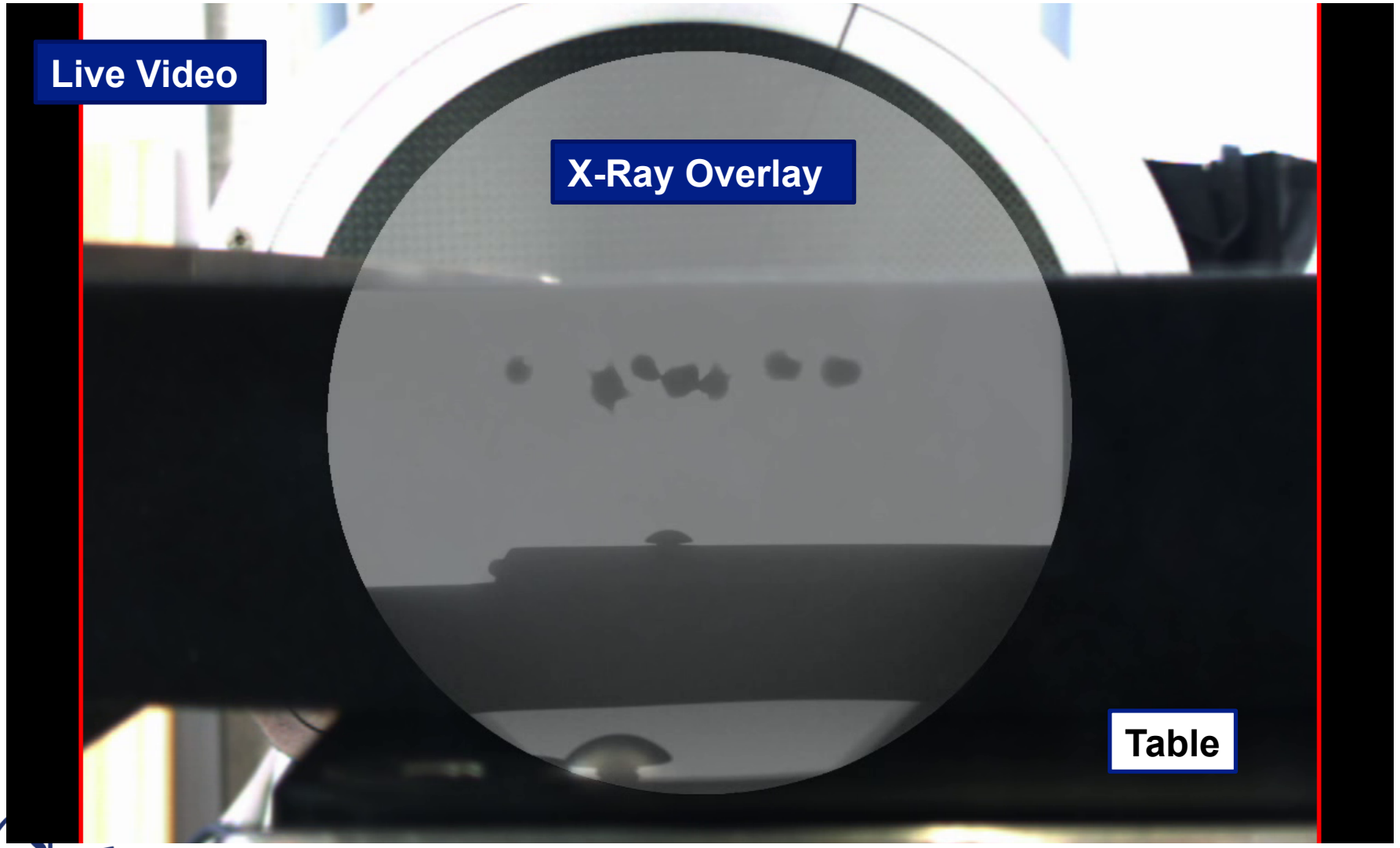


Navab, Nassir, A. Bani-Kashemi, and Matthias Mitschke. "Merging visible and invisible: Two camera-augmented mobile C-arm (CAMC) applications." Augmented Reality, 1999.(IWAR'99) Proceedings. 2nd IEEE and ACM International Workshop on. IEEE, 1999.

2. CamC Technology (Prior Works)



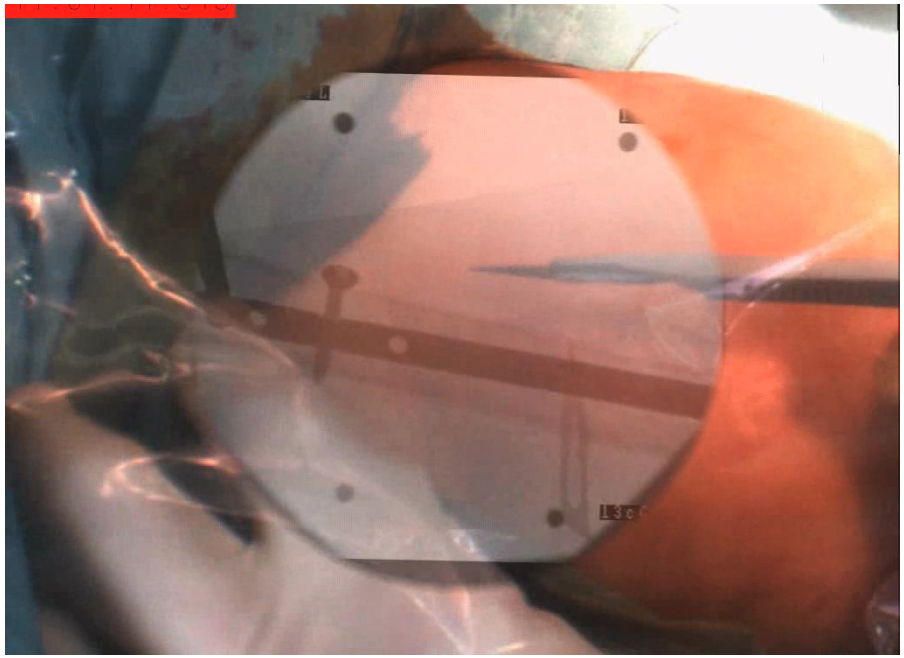
2. CamC Technology (Prior Works)

Applications

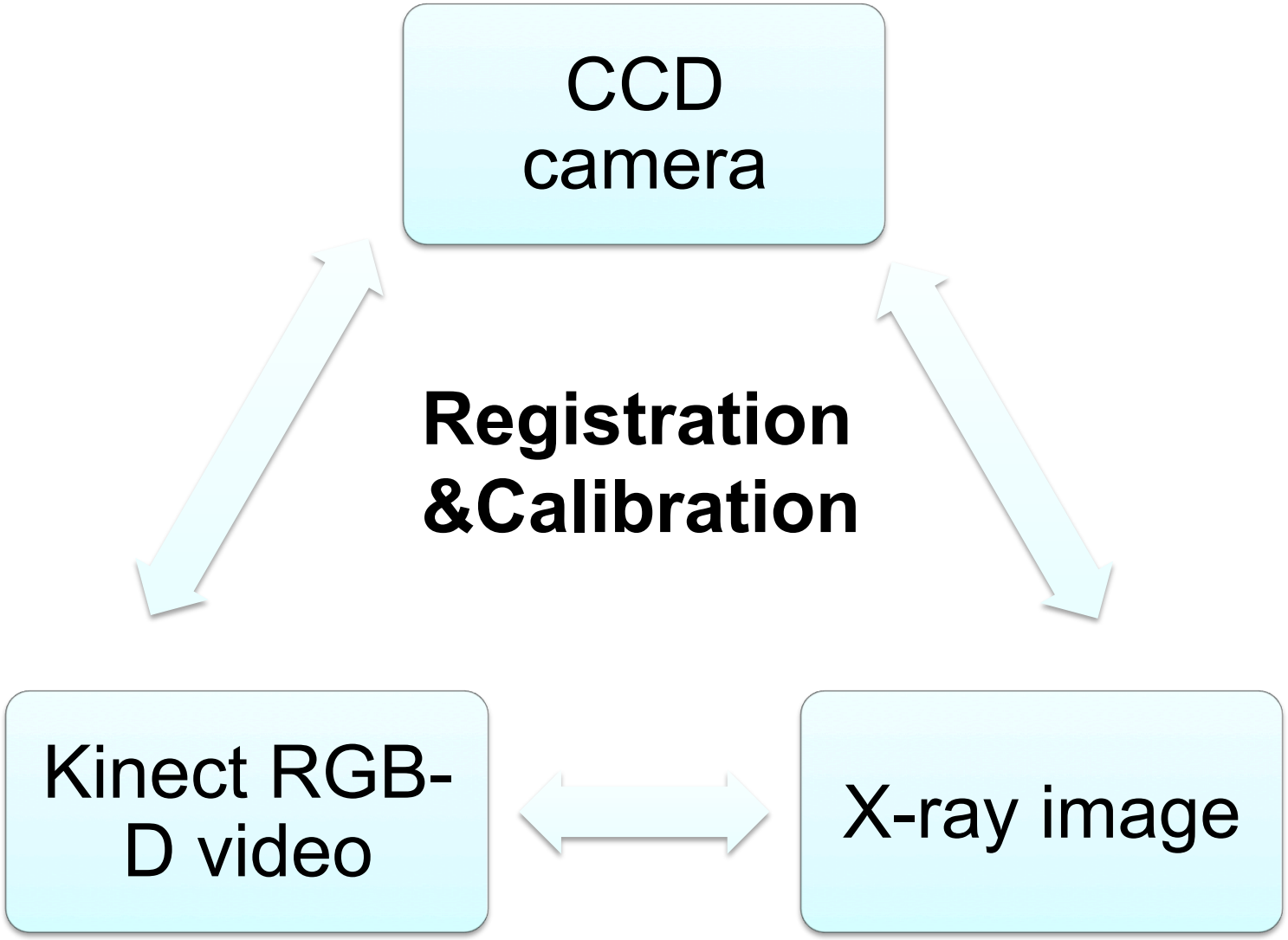
- Needle guidance
- Trauma: interlocking of intramedullary nails (CIS I)
- Implant/Foreign-body removal
- X-ray positioning

Advantages

- Reduce radiation exposure
- Offline calibration
- Assist current surgical procedure



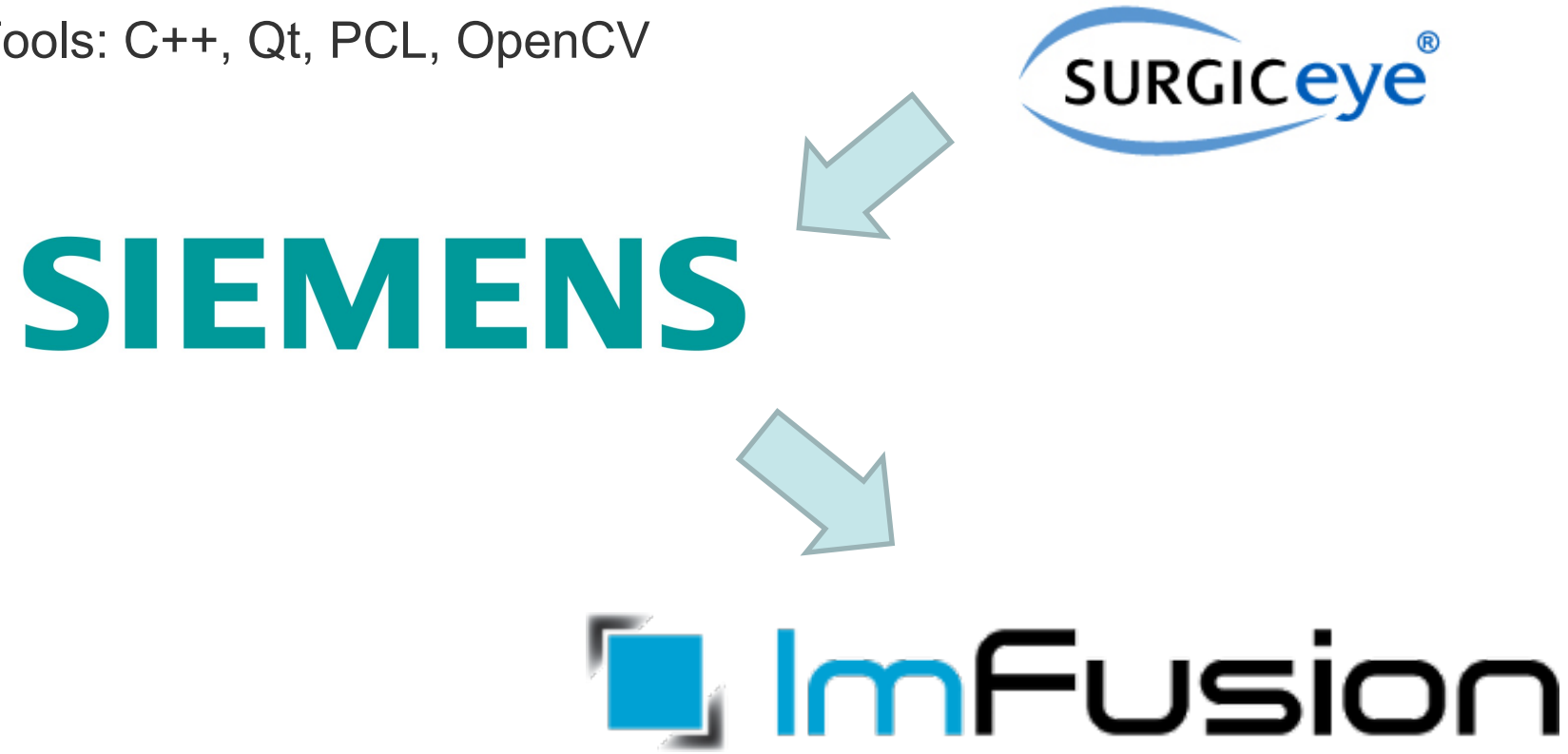
3. Key Technologies



3. Key Technologies

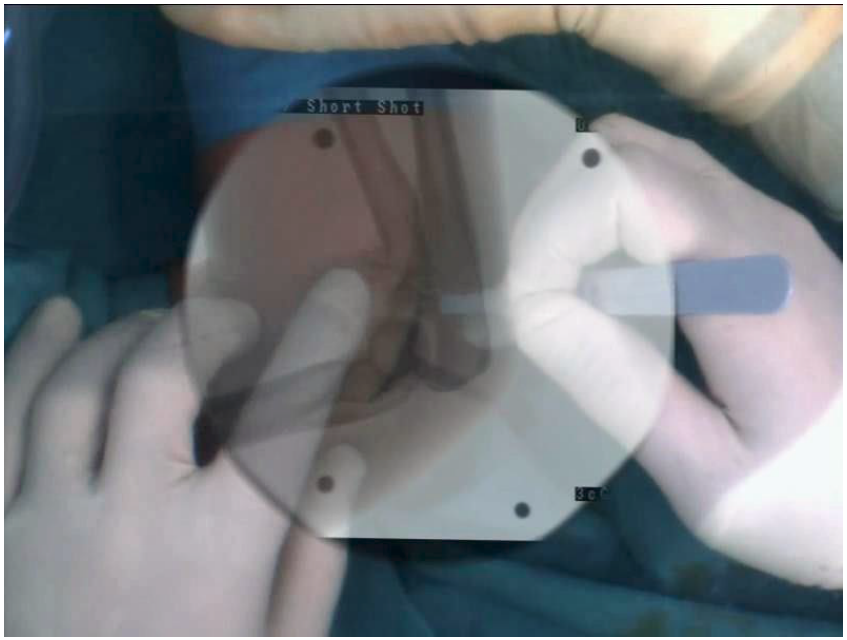
Software Development

Tools: C++, Qt, PCL, OpenCV



4. Specific Aims

- Develop an ImFusion plug-in for CamC, and fuse the x-ray image with the video
- Mount Kinect sensor + get RGBD data from ImFusion
- Develop registration algorithm
- Enhance augmented view
- Phantom validation
- Evaluation



1. Mitschke et al. MICCAI 00.
2. Heining et al. CAOS 2006
3. Heining et al. IGCARS. 2006
4. Navab et al. IEEE TMI 2010

5. Deliverables

- **Minimum**

ImFusion plugin, mounting kinect, and sensor reading. These three functions are the basis for the depth perception of CamC. They must be completed for further applications.

- **Expected**

Registration algorithm and enhanced overlay. These are the main goals of the project. At the end, we should be able to intelligently render X-ray overlay according to depth information.

- **Maximum**

Phantom validation and surgical procedure evaluation. We invite residents to perform simulated surgery with the new system on the animal phantom.

6. Dependencies

- **C-arm**
  - Radiation safety training (done)
  - Radiation badge
  - Access to C-arm and Mock OR
- **Equipment**
  - A fast PC from CAMP lab
  - A Microsoft Kinect2 from CAMP lab
  - Kinect mounting supports
- **Software**
  - ImFusion software
  - Siemens CamC software
  - Kinect SDK, OpenNI
- **Mentoring**
  - Weekly meeting with Dr. Navab
  - Supports from Bernhard and Javad

7. Reading Lists

- **Camera Augmented Mobile C-Arm (CAMC): Calibration, Accuracy Study, and Clinical Applications.** IEEE Transactions on Medical Imaging, Vol.29,No.7,July 2010

- **Merging visible and invisible: two Camera-Augmented Mobile C-arm (CAMC) applications.** Augmented Reality, 1999. (IWAR '99) Proceedings. 2nd IEEE and ACM International Workshop

- **Workflow Based Assessment of the Camera Augmented Mobile C-arm System.** International Workshop on Augmented Reality environments for Medical Imaging and Computer-aided Surgery (AMI-ARCS 2008), New York, NY, USA, September 2008

- **Long bone X-ray image stitching using Camera Augmented Mobile C-arm.** Med Image Comput Comput Assist Interv. 2008;11(Pt 2):578-86.

8. Management Plan

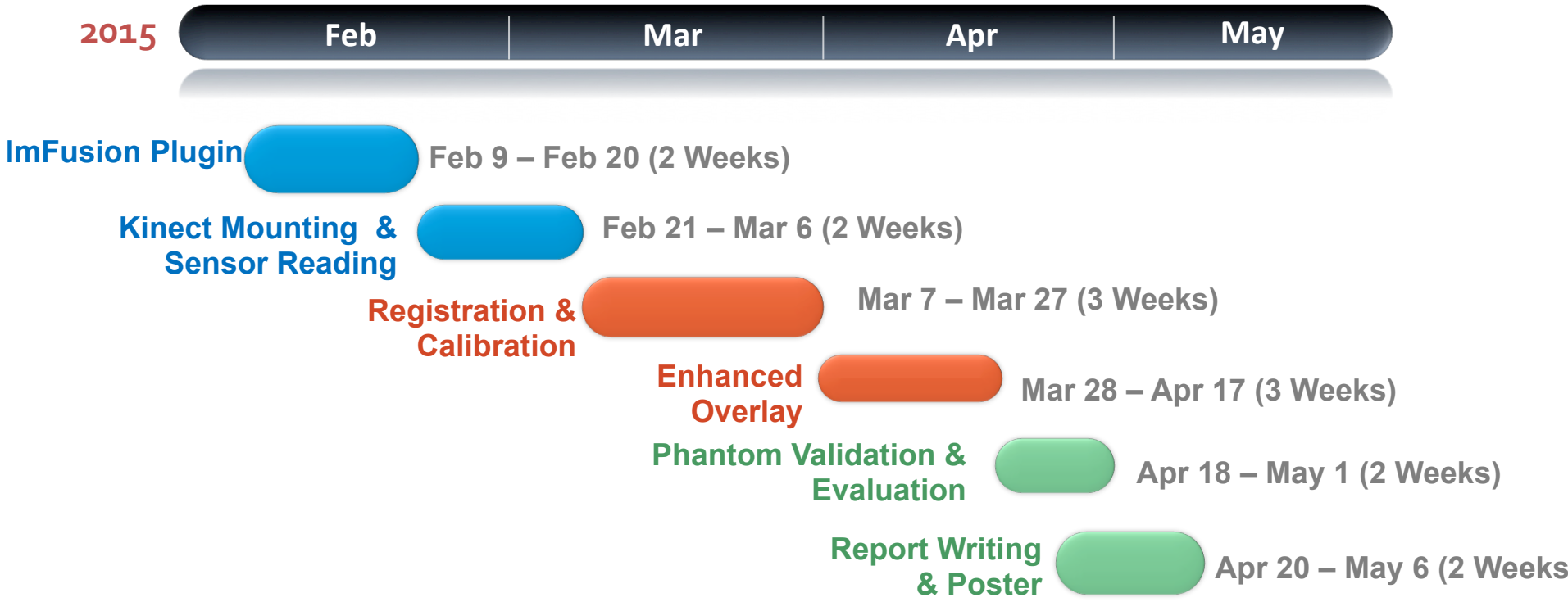
- **Programming Language:** Mostly C++

- **Decision Making:** Weekly meeting with Dr. Navab and CAMP members to discuss the project.

- **Version control:** Git

- **Documentation share:** Remote Desktop, Dropbox

9. Timeline


2015
Feb
Mar
Apr
May
ImFusion Plugin
Feb 9 – Feb 20 (2 Weeks)
Kinect Mounting & Sensor Reading
Feb 21 – Mar 6 (2 Weeks)
Registration & Calibration
Mar 7 – Mar 27 (3 Weeks)
Enhanced Overlay
Mar 28 – Apr 17 (3 Weeks)
Phantom Validation & Evaluation
Apr 18 – May 1 (2 Weeks)
Report Writing & Poster
Apr 20 – May 6 (2 Weeks

Thanks for your attention!

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