

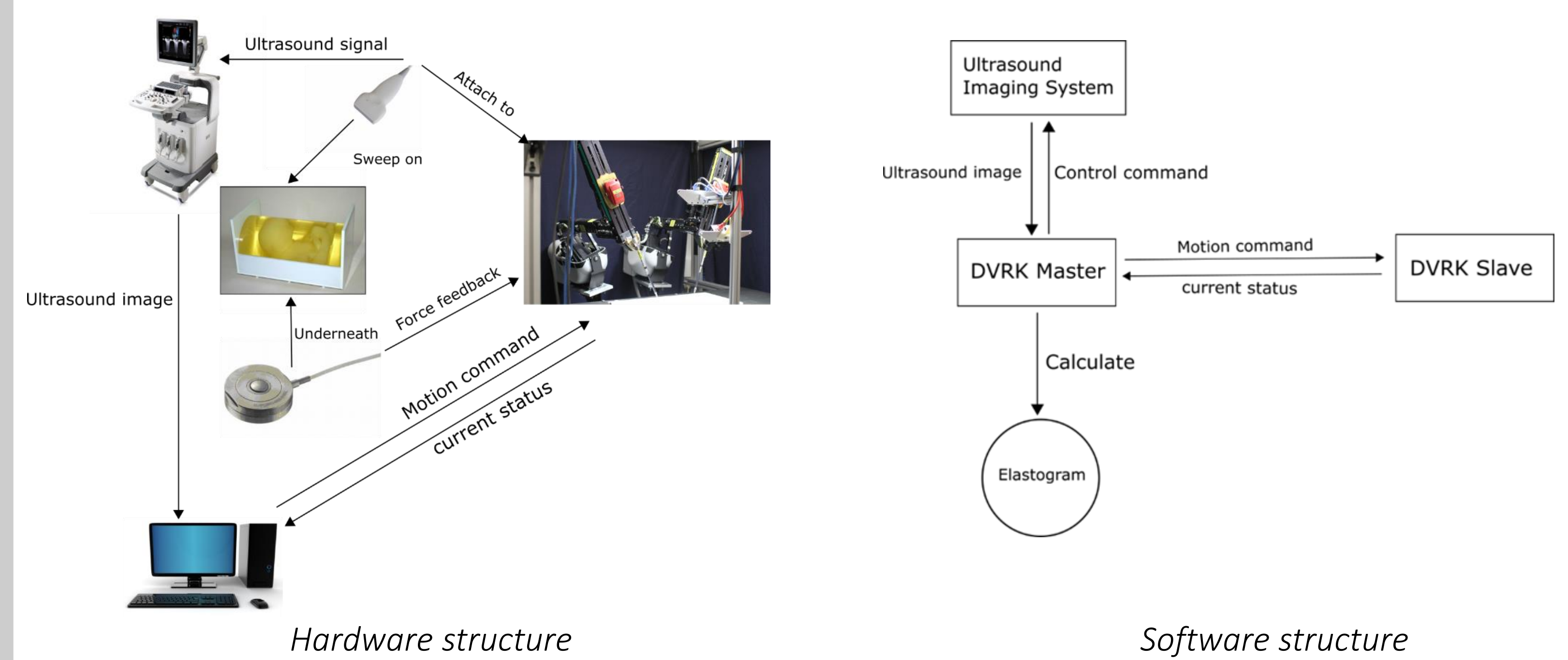
Group 18 - Xingtong Liu

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Motivation

- Ultrasound elastography is a good way to detect stiff features at various depths intra-operatively and is not limited to only superficial ones like Palpation. However, free-hand ultrasound elastography is a challenge even for experienced doctors.
- Robot assistance has played an important role in surgery due to its high accuracy, safety and efficiency. In order to obtain consecutive high-quality elastography images in real-time, it is necessary to reach out for the help of a robot.

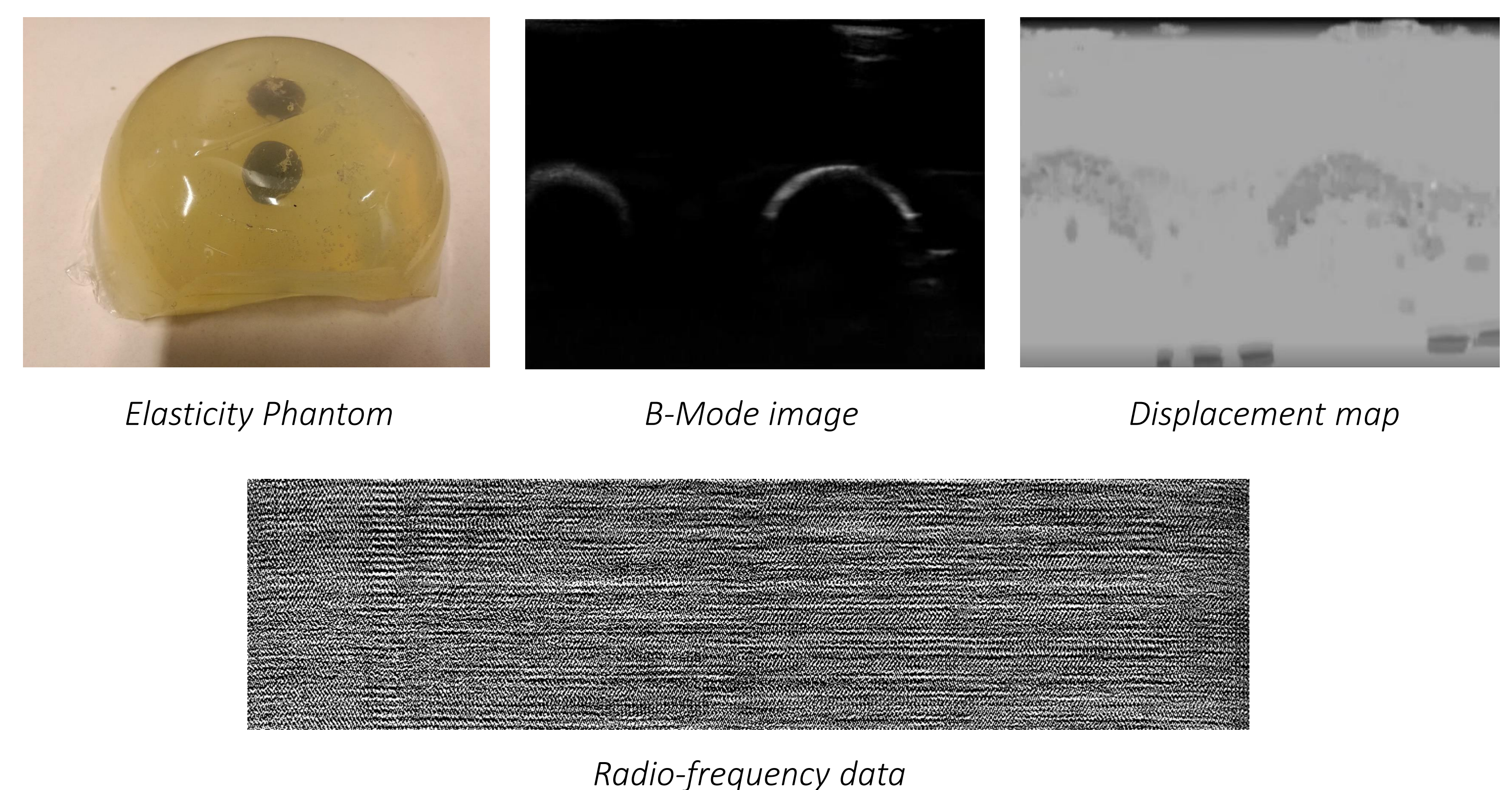
Structure Diagram



Goal

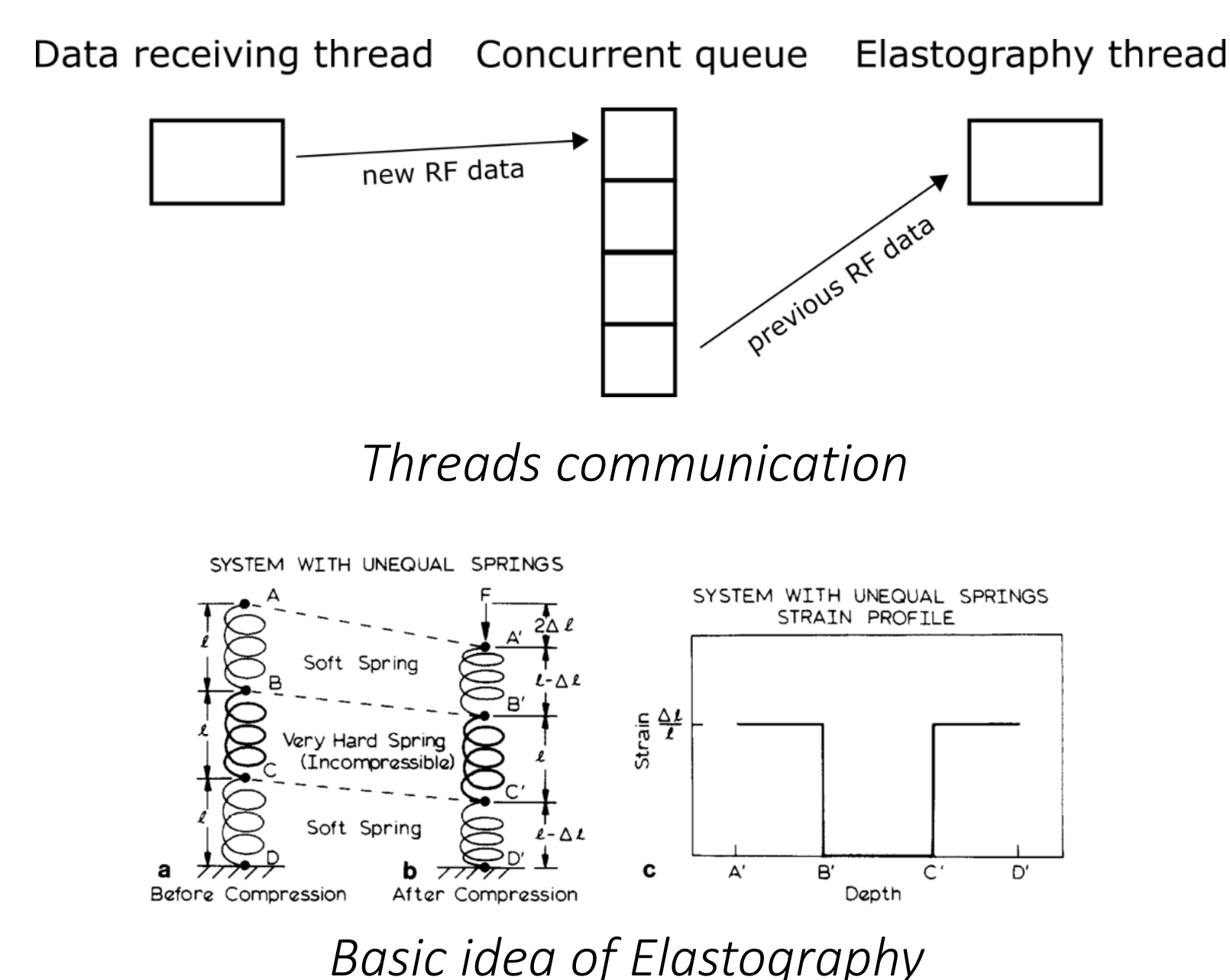
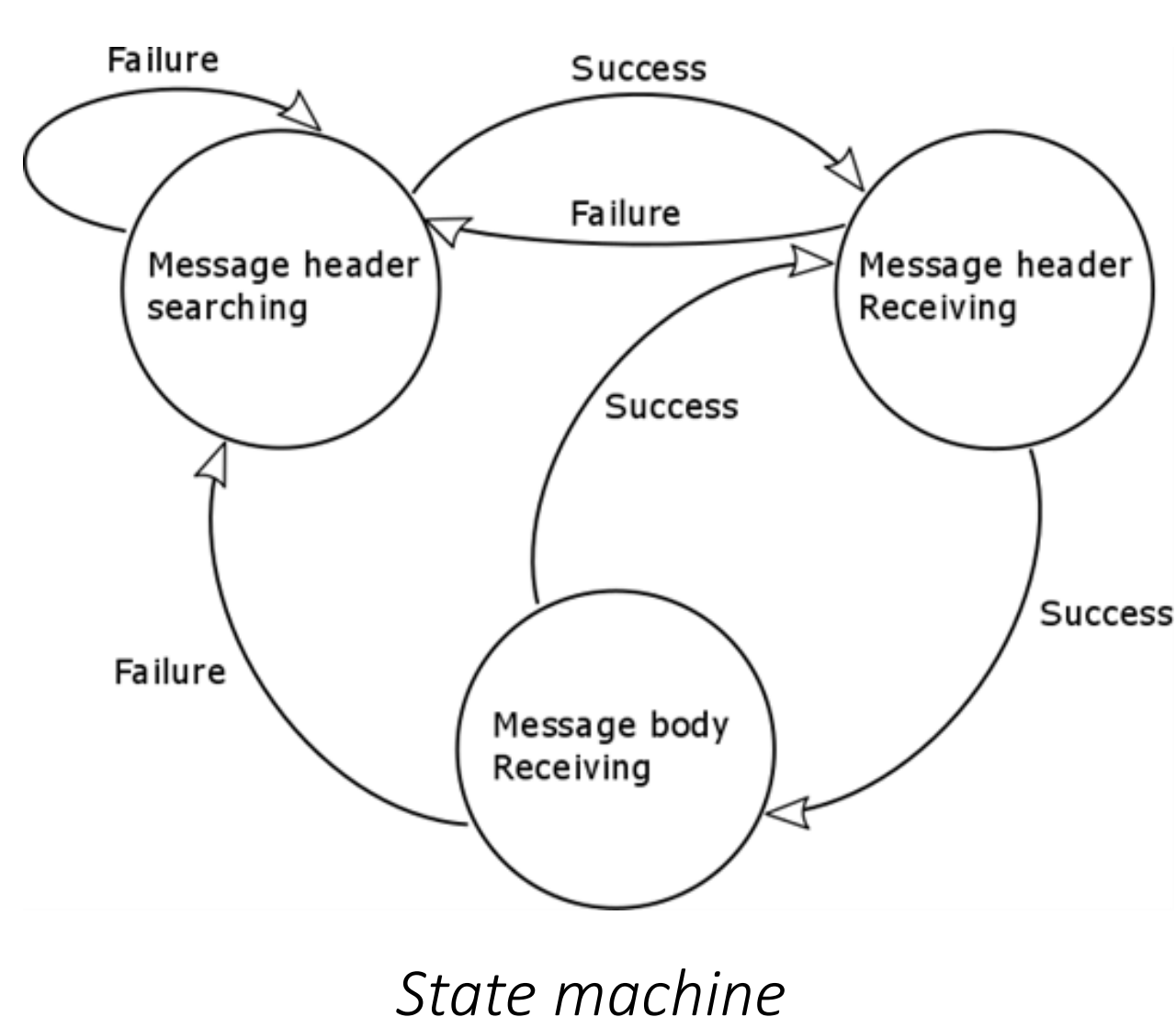
- da Vinci Research Kit (dVRK) is an open-source platform for researchers to develop algorithms for computer assisted surgery. Previously there was no ultrasound elastography module integrated.
- In this project, we aim to develop and integrate this module to the dVRK system to allow for relevant future research such as intraoperative registration, tumor recognition and so on.
- With the completion of this project, the dVRK system is able to receive Ultrasound data from ultrasound machine and display it and compute ultrasound elastogram with radio-frequency (RF) data in real time.

Results



Methods

- Used OpenIGTLink Library as the standardized mechanism for ultrasound data communication.
- Designed a state machine to efficiently search for messages in a long bit stream.
- Used multi-thread programming to process multiple tasks simultaneously.
- Used asynchronous non-blocking I/O model for socket programming.
- Used cross-correlation elastography method with GPU acceleration to compute ultrasound elastogram in real time.
- Used concurrent queue for data communication between multiple threads.



Conclusions and Future Work

- We have designed a Robot Operating System (ROS)-based real-time ultrasound elastography module which can be easily integrated to the dVRK system.
- We need to replace the original da Vinci ultrasound probe with a new drop-in probe to make it suitable for scan plane calibration and teleoperating palpation in order to fully take advantage of the dVRK system.
- Current cross-correlation elastography method is very sensitive to signal decorrelation. We need to further improve the method with techniques such as global stretching or adaptive stretching to make it more robust in practice.

Citations

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