Dr. **Jaydev Desai** (Georgia Tech). Title: "Challenges in Transcatheter and Endovascular Interventions".

I do not know much about the subject Dr. Desai is presenting but the slide capturing the “Brief History of Surgical Robots is Interesting.” In particular, seeing the progression from robot arms, to robotic manipulators, and then finally robotic catheter systems and the scale progression from larger robots down to smaller and more customized robots is all pretty amazing. It mirrors how computers, in general, got smaller and smaller over time in different components and in different areas. i.e. Eniac to IBM PC to our current phones.

Pivoting to the overall subject of the lecture, Dr. Desai motivates the discussion by defining what Mitral Regurgitation (MR) is. When the blood in the heart pumps out the mitral valve in the heart does not function correctly which causes blood to flow back into the left atrium. “This condition affects 10% of the adult population over the age of 75.” (speaker quote) It can cause fatigue and general malaise and there is the risk of heart failure. The treatment options are classified as either microvalve repair or microvalve replacement. In general, you do not want to do replacement due to the many complications of the procedure so the focus is really on microvalve repair. A robotic delivery system has the potential to improve this procedure, especially if the whole procedure can be accomplished without the need for open heart surgery.

The first part of the presentation looks at some of the trans-catheritic technologies that have been developed over the last five years. The first generation design that was presented was a huge device which was mainly developed, not for the actual repair procedure, but to learn lessons relating to what the overall final structure of the robot should look like. (Aside: I like the pie chart Dr. Desai presented which was color coded according to the design problems being overcome. The colors in the pie chart would change during each iteration from red towards green as the design kept improving in certain areas.) The second generation reduced the size of the robot from 10.6 mm to 5.7 mm which met the clinical requirements. The third generation has many improvements such as a longer prismatic joint, dedicated routing to avoid friction, and kinematic modeling. The clinical requirements are also much improved with all of the joints meeting or exceeding the clinical need. Generation 4 continues improvements and this generation begins to make progress in en-vivio studies. The final full scale system makes some crucial improvements regarding the guide tube, remote control capability, and the bending joints.

The second part of the presentation delves into robotically steerable guidewires. These are analogous to a plumber’s snake in the sense that they clear out clogs with the difference being that the clog is in a human artery. For example, a guidewire can go in one leg and down the other side and past the blockage in the leg artery. The wire then becomes a delivery system for a device that can break up the blockage. Interesting quote from the physician working with Dr. Desai, “I have the best google map of the body but the problem is I do not have a car to go from a to b.” The central message given in this part of the talk is, “Tortuous anatomy is at the CORE of technical failure in endovascular interventions.” (presenter’s slide) In his talk Dr. Desai focused on the coaxially aligned steerable guidewire robot. The guidewire is only 400 microns in diameter! The operator can not only control the bending angle of the tip but also controls how much of that wire is going to bend. This is accomplished by building a tube within a tube within a tube. The whole robot is so small that you can hold it in the palm of your hand. To improve the steering even more, a colleague is working on putting an ultrasound device at the tip of the wire.

Dr Desai ends with a slide on funding and then on a slide about the 2024 International Symposium on Medical Robotics.