Modeling and Control of Continuum
Active Catheter for Aortic Aneurysm

Sohail IQBAL
LISSI Lab, Univ. Paris 12
iqbal@univ-paris12.fr

3rd Summer School in Surgical Robotics
Montpellier, September 5-12 , 2007
AORTA AND ANEURYSM

- **Aorta**: Largest artery of human body
- **Aneurysm**: Dilatation of the aorta

1. High mortality rate: 80% to 90%
2. 13th leading cause of death in the United States
Open Surgery

Drawbacks
- Severe procedure
- Long period of hospitalization and convalescence
- Cost
ENDOVASCULAR STENTING

ADVANTAGES:
1. Less trauma
2. Shorter hospitalization
3. Cosmetic benefits
4. Less expensive
Here we can see the three different versions of our Micro catheter:

(a) Version 0,  (b) Side View V1(down) V2(up)   (c) Top view
System of Endovascular Treatment for Aortic Aneurysm

**MicroCatheter**

- Structure of micro-robot is inserted in a flexible tube.
- Central Module: Maintains the structural rigidity and prevents the extreme bending of bellows.
- Dimensions of micro-robot: Compatible with the dimension of the standard catheters, used for the treatment of Aortic Aneurysm

Dimensions of prototype v.2

- Diameter: 4.9 mm
- Length: 20 mm
- Work Channel: 2 mm of diameter
Modeling Highlights
Experimental Set-up

- HUMAN
- RT environment
- amplification
- servovalve
- hydraulic actuator
- CATHETER
- camera
- hydraulic power plant
- pressure sensor
- vision

Legend:
- green: electric circuit
- orange: hydraulic circuit (oil)
- blue: hydraulic circuit (biocompatible liquid)

Prototype v.2
1. To perform path planning and its simulations.

2. Error propagation analysis, as a small error in the function linking pressures and lengths of the bellow could be costly at controlling the tool position (Can we take measures to minimize the cumulative error?).

3. Working for the robust and adaptive motion control.
Conclusion

- Design of a new generation of active catheters for aortic aneurysm treatment
- Classification of research categories
- Modeling of a hybrid continuum style micro-robot for N-Modules
- Orientation control with experimental results
Thank You for Your Attention!

Questions?