

# Needle Biopsy Simulator using Virtual/Haptic and Physical Phantom

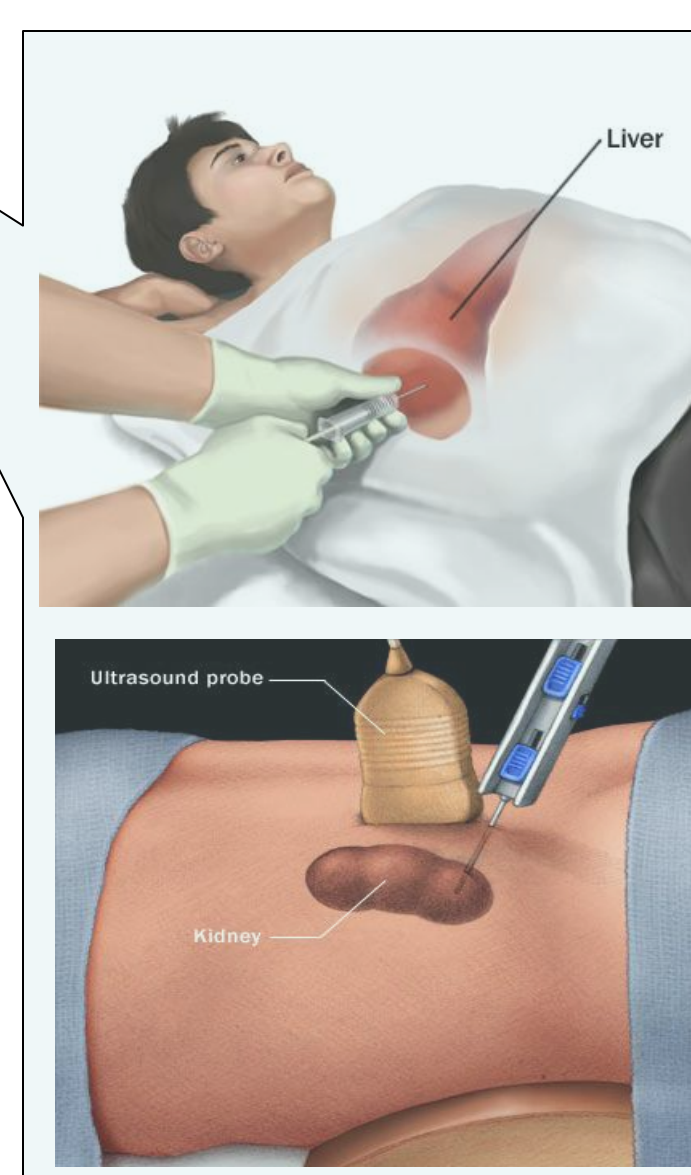
## Biopsy – Current Scenario

Procurement of small tissue samples from internal organs like kidney, liver, lung etc.

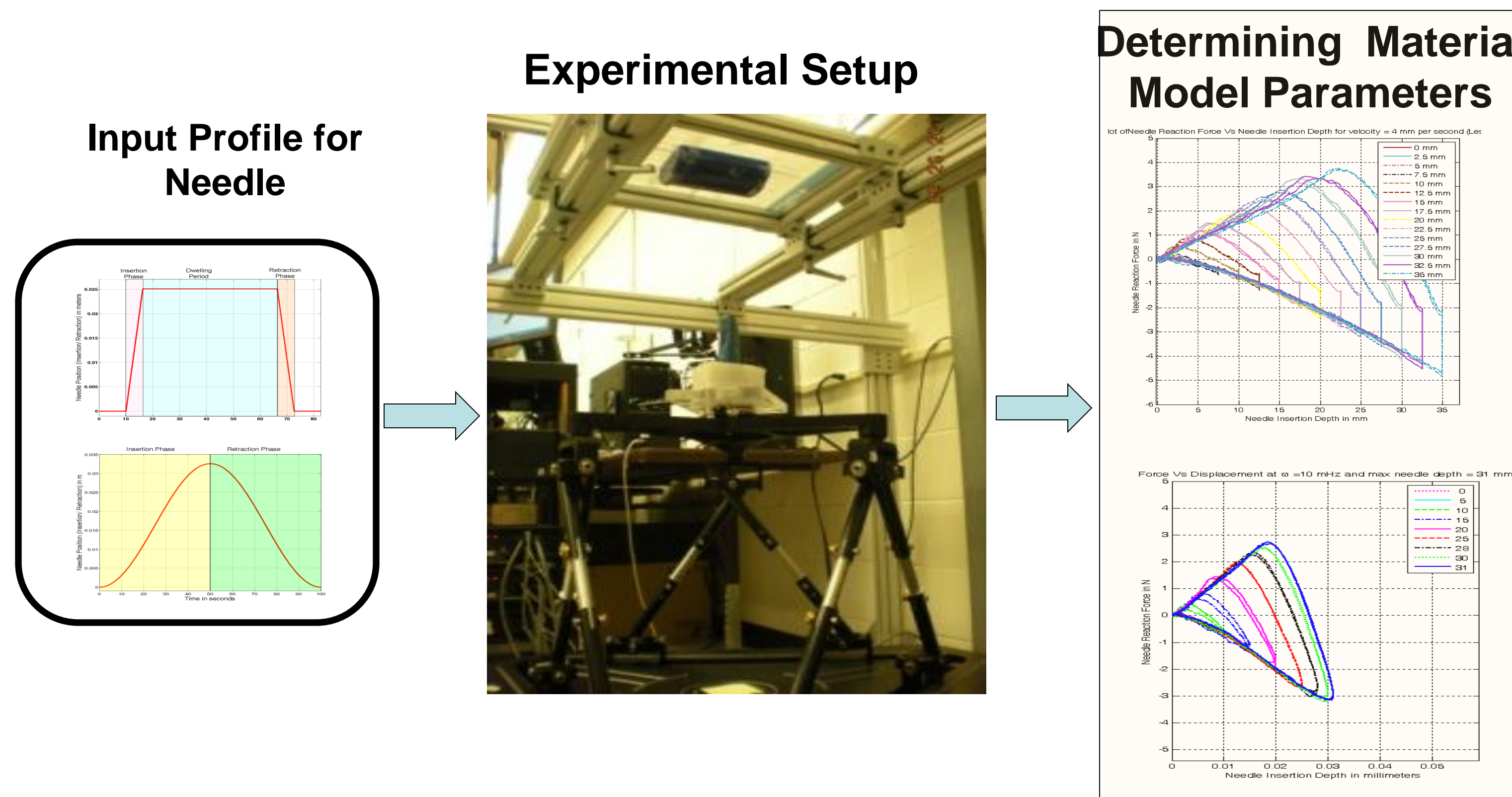
### “See one, Do one, Teach one”

-Trainees expected to develop sense of “touch”  
-Inadequate, non-uniform and improper training methods

**Statistics:** 20 million Americans are affected with chronic kidney disease, of which 50000 have kidney cancer. **Net government expenditure > \$2 billion** on the treatment of kidney cancer. [http://www.nkdep.nih.gov]



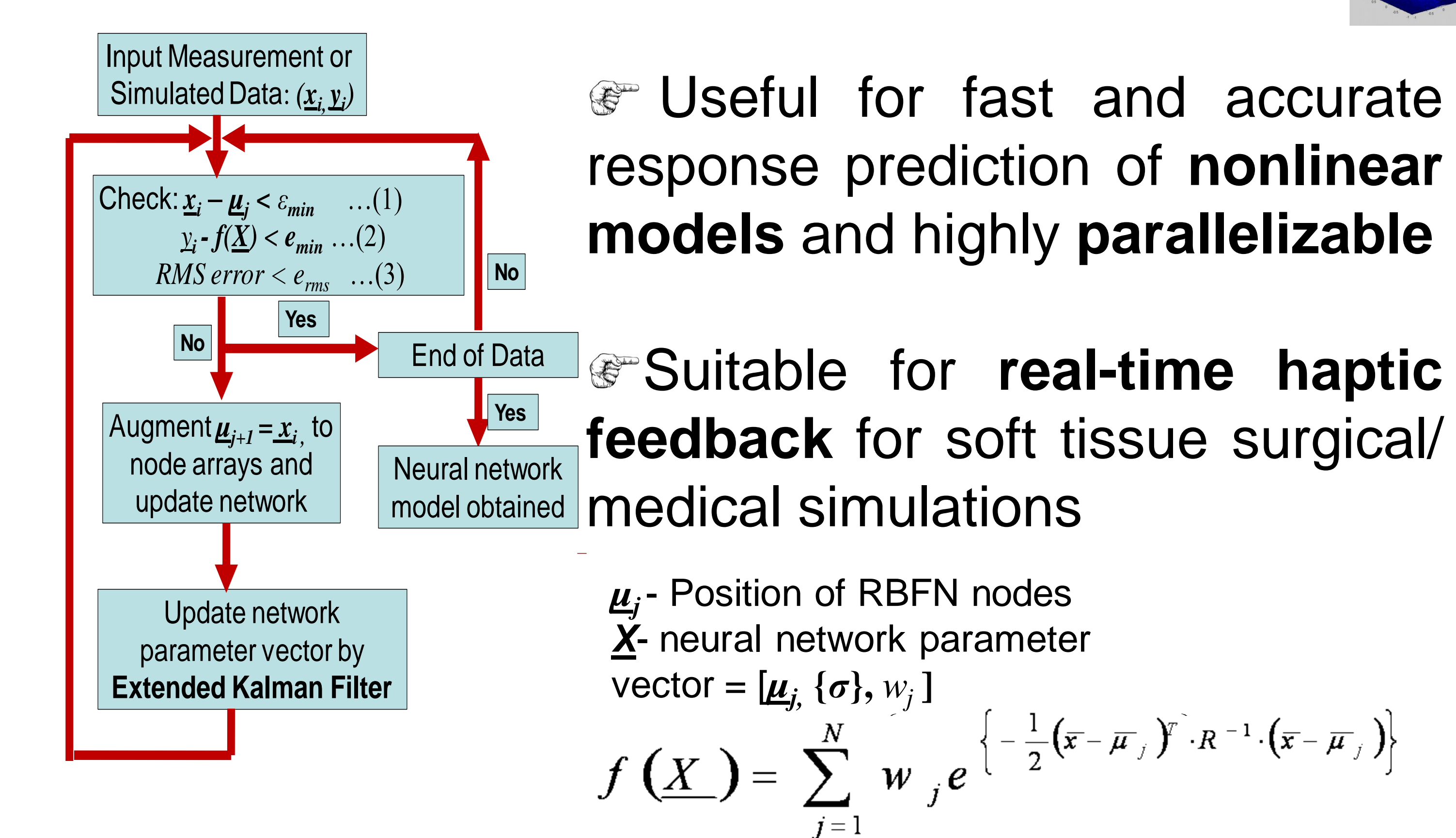
## Soft Tissues Model Parameterization/ Results



Material Model Fitting Parameters			
	Insertion		Retraction
$a_0$	0.1715	$a_0$	0
$a_1$	0.0739	$a_1$	.05111
$a_2$	1.9734	$a_2$	1.7649

$f(x) = a_0 + a_1x + a_2x^2$

## Radial Basis Function Network- Approximation

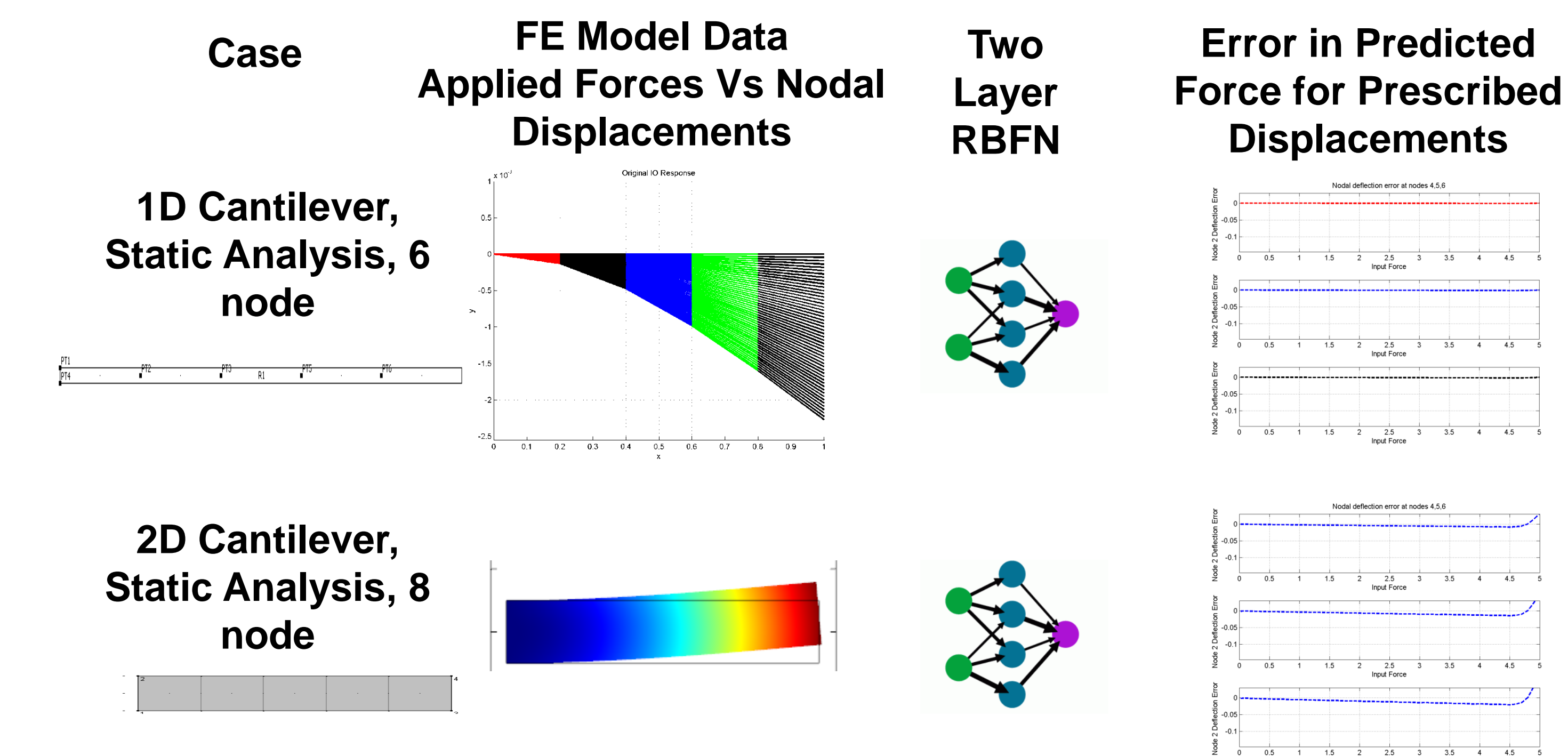


## Goals

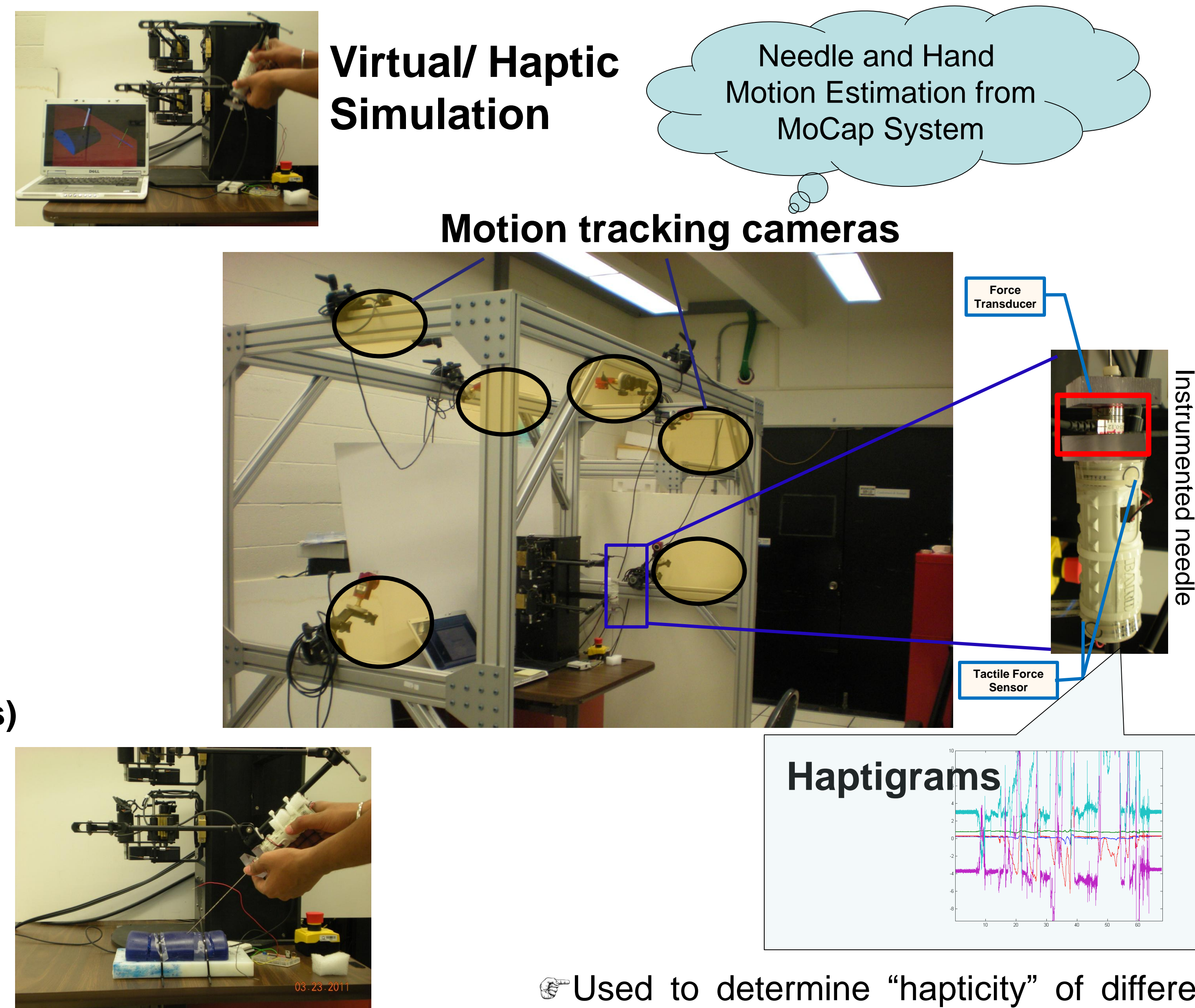
- Surgical **simulator-trainer** for percutaneous needle biopsy procedures using virtual and physical phantoms
- Develop **quantitative metrics and assessment tools** with customized training
- Design a framework to study and compare the performance/ fidelity of the simulator across different categories



## Results (RBFN Based FEA Approximation)



## Physical and Virtual/ Haptic Operation- Device Setup

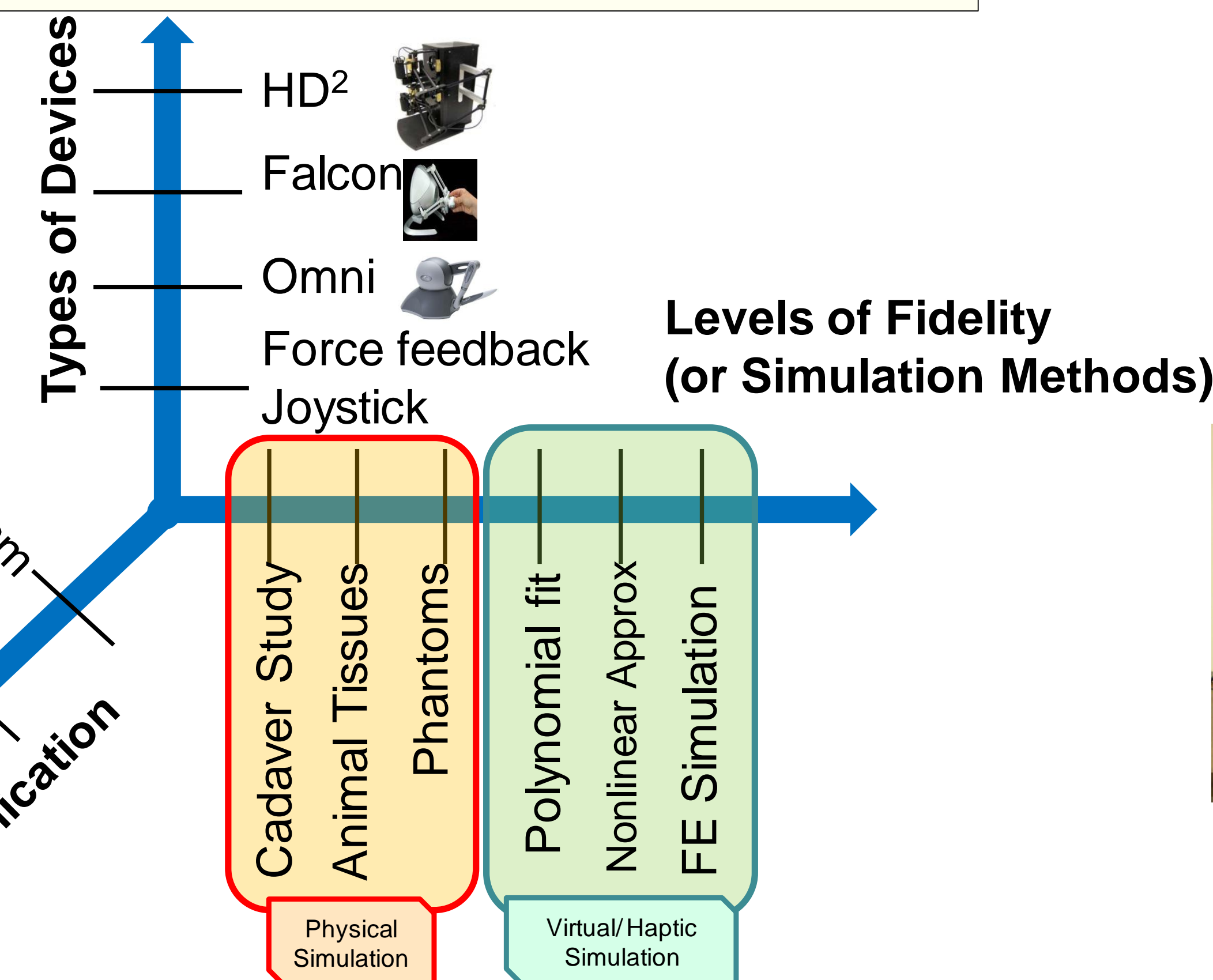
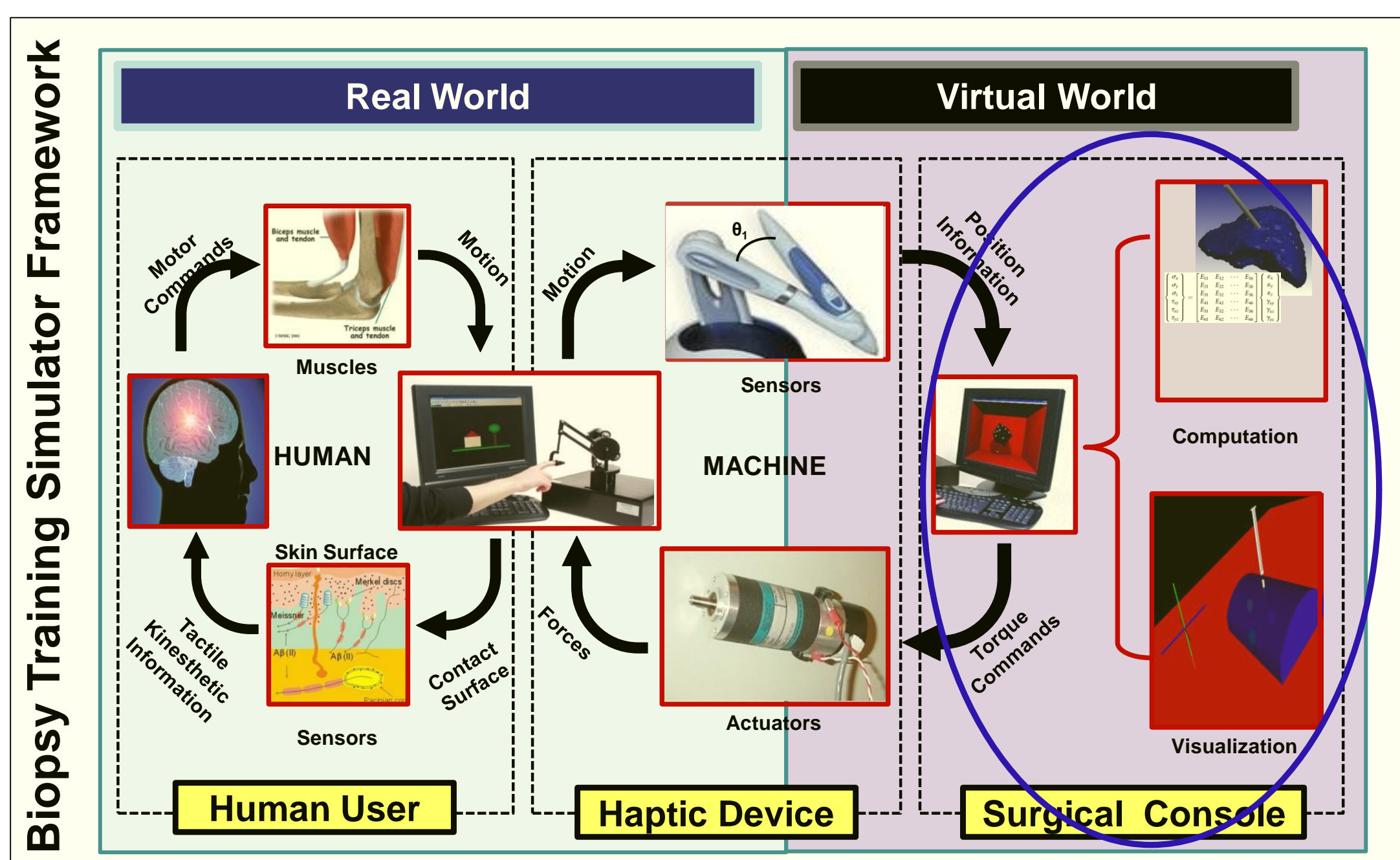


## Future Work

- Subject studies for comparative analysis between experts and trainees surgical patterns, performance of different haptic devices, analyzing fidelity of haptic models etc...
- Teleoperation framework for instructor-student teaching
- Extend the existing RBFN to transient systems

## Selected References

[1] M S Narayanan *et al.*, Neural Network Approximation of Finite Element Models for Real-Time Simulation, DSCC 2011 (in review)  
 [2] MS Narayanan *et al.*, Integrated Virtual and Physical Validation of Needle Biopsy Phantom, IROS 2011 (in review)  
 [3] P. Singla *et al.*, Multi-Resolution Methods for Modeling and Control of Dynamical Systems



## Physical Simulation

Used to determine “hapticity” of different materials  
 Useful to compare tremors of trainees with smoothed force distribution of experts