



Endoscopic Carpal Tunnel Release Surgical Simulator

Sarah Switalski --Whitney Johnson -- Mason Jellings

Clients

Dr. Robert Radwin, PhD

Dr. Ben Mandel, MD

Advisor

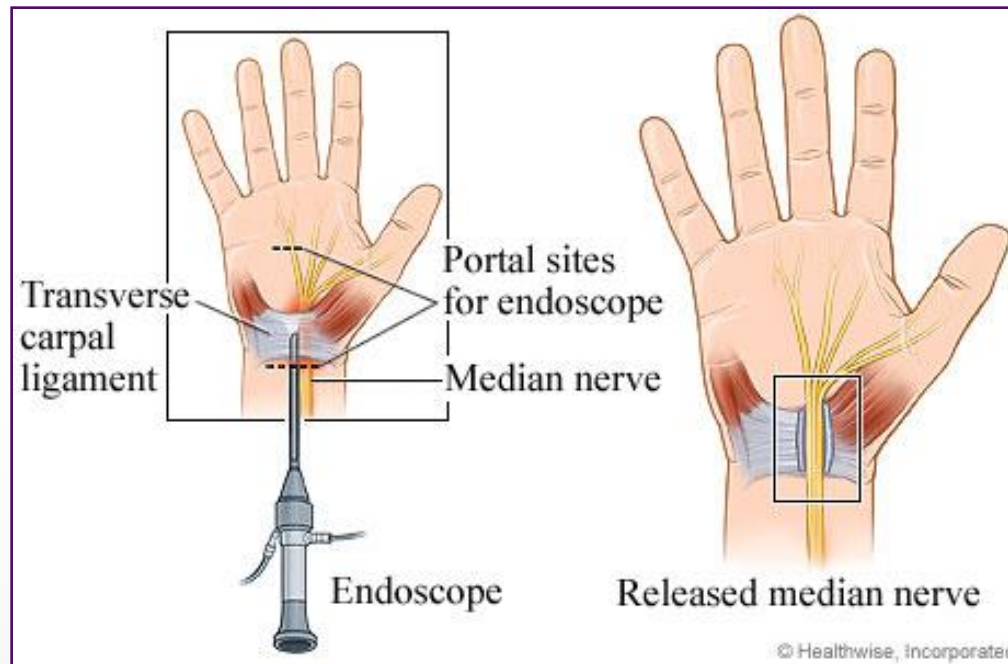
Professor Thomas Yen

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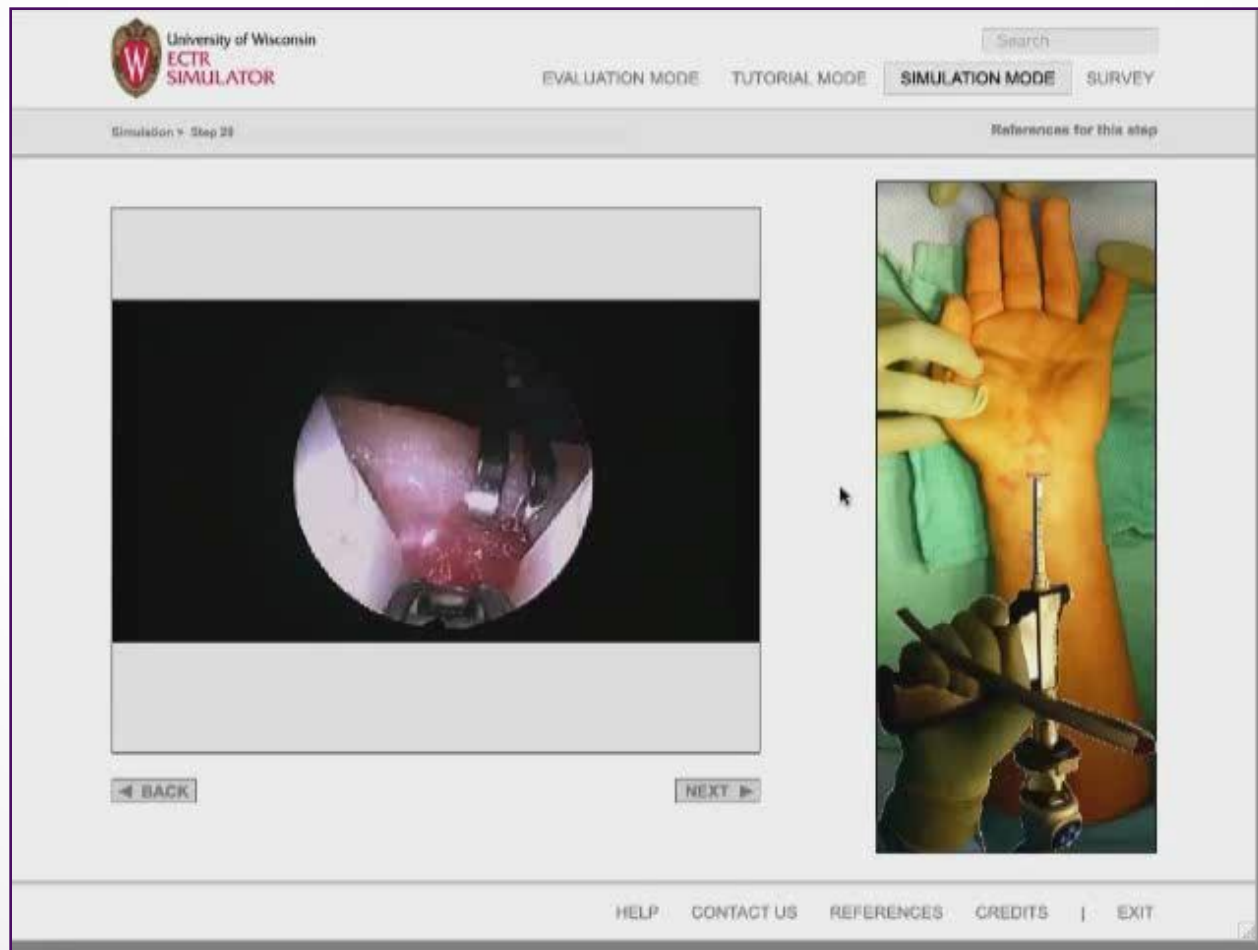
Background

- Carpal Tunnel Syndrome Release Surgery
 - Relieve pressure on median nerve
- New, cost efficient system for training
- Part of training package



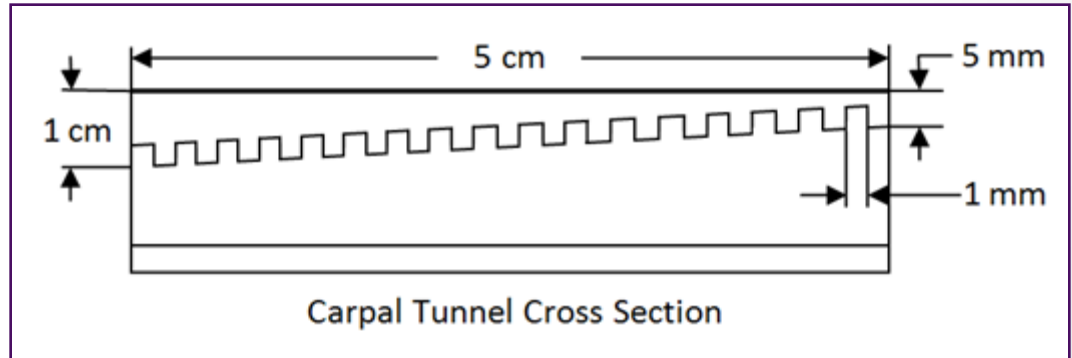
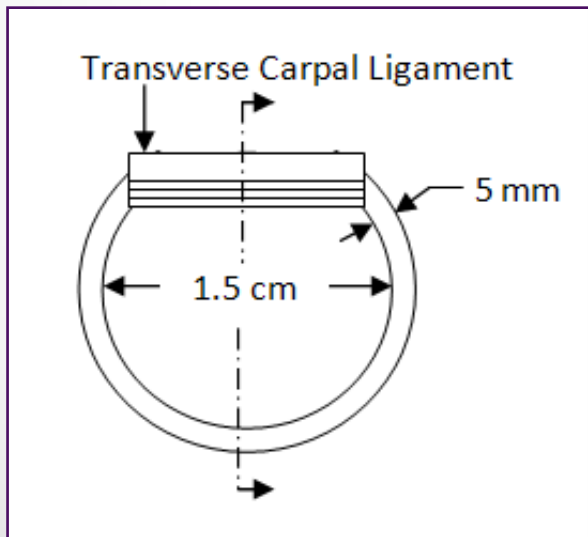
Current Simulator

- Tracking Software
 - No force feedback



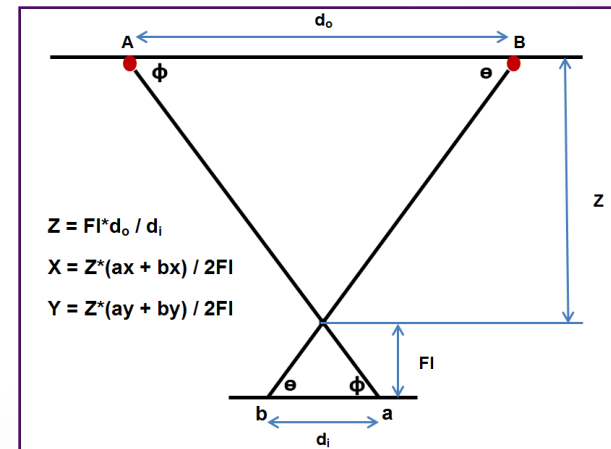
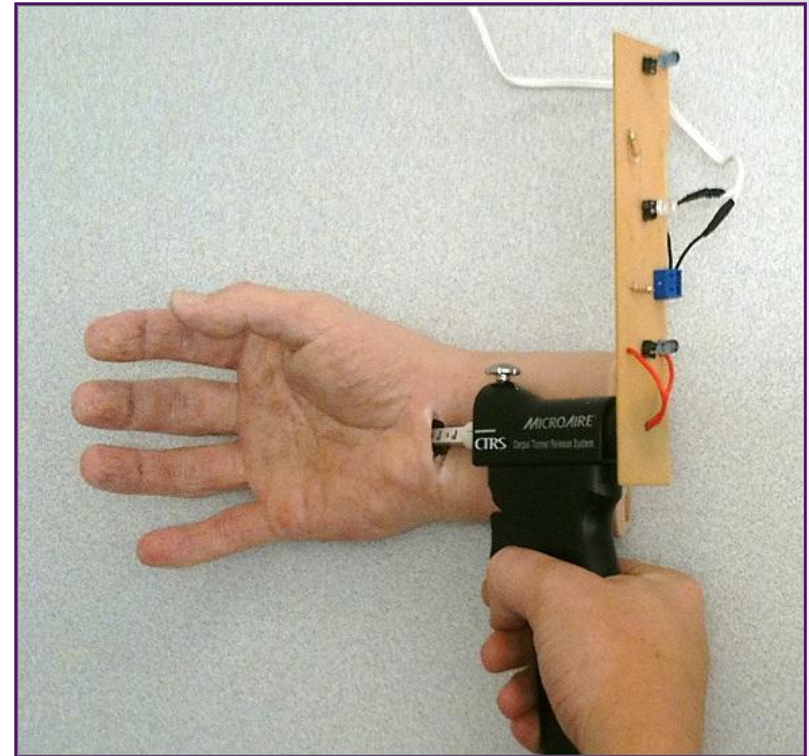
Client Specifications

- Realistic haptics
- Accurate visual simulation
- No external interference
- Durable



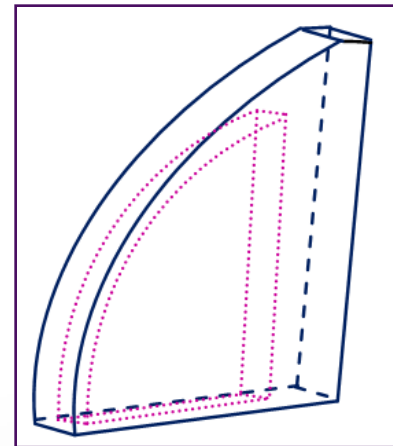
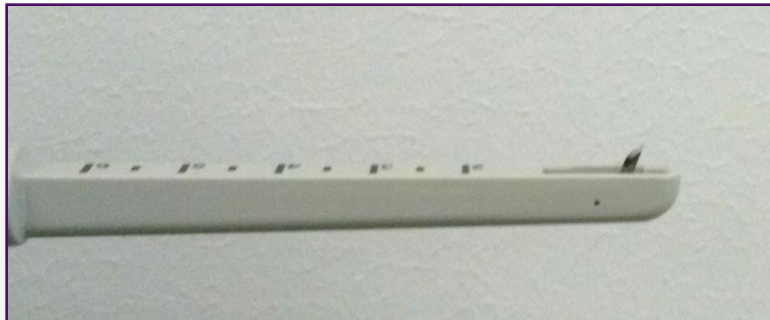
Current Prototype Status

- Tracking device
 - Possible improvements
 - Circuit attachment
 - Circuit aesthetics
- Functional hand model
 - Possible Improvements:
 - Reduce thickness of ligament
 - Modularize ligament section



Design Alternatives: Blade Cap

- Plastic cap fit around current blade
- Will not interfere with retractable mechanism
- HDPE, Polyurethane
- Varying height and width
 - Based on surgeon feedback



Blade Cap

Solenoid Activated

- Band embedded around carpal tunnel
 - Metal, nylon webbing
- Pull-type solenoid connected via digital I/O
 - Activated state constricts tunnel diameter
 - Voltage output when trigger activated
 - Pulsed to simulate corrugations

**Trigger
activated**



**High-voltage
digital output**



**Pull-type
solenoid**



http://sine.ni.com/nips/cds/pages/image?imagepath=/images/products/us/05200515_1.jpg&title=NI%20USB-9472&oracleLang=us

<http://www.mcmaster.com/#electric-solenoids/=ba2s5x>

Motor Activated

- Band embedded around carpal tunnel
 - Metal, nylon webbing
- Stepper motor connected via digital I/O
 - Voltage output when trigger activated
 - Constant resistance, cannot be pulsed

**Trigger
activated**



**High-voltage
digital output**



**Stepper
motor**



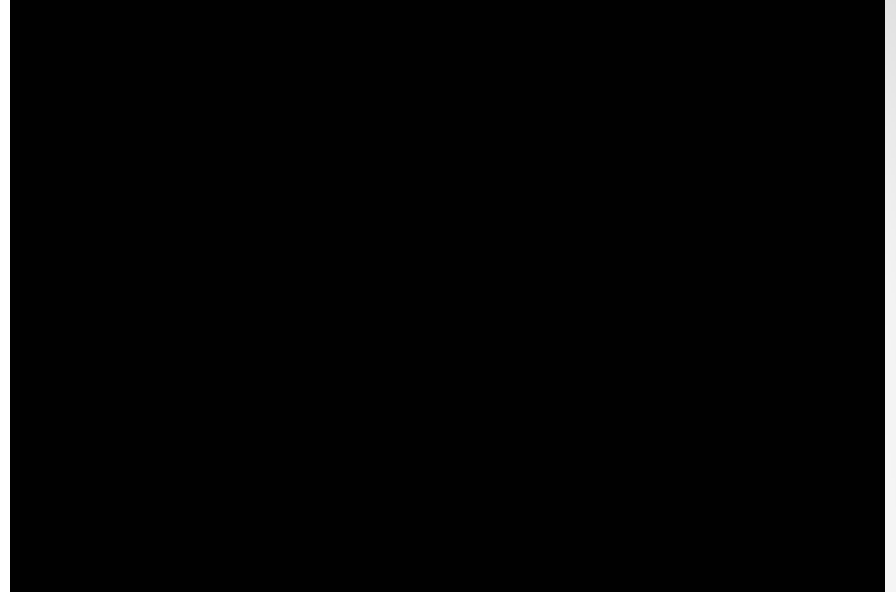
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<http://www.mcmaster.com/#stepper-motors/=ba2j2w>

Design Matrix

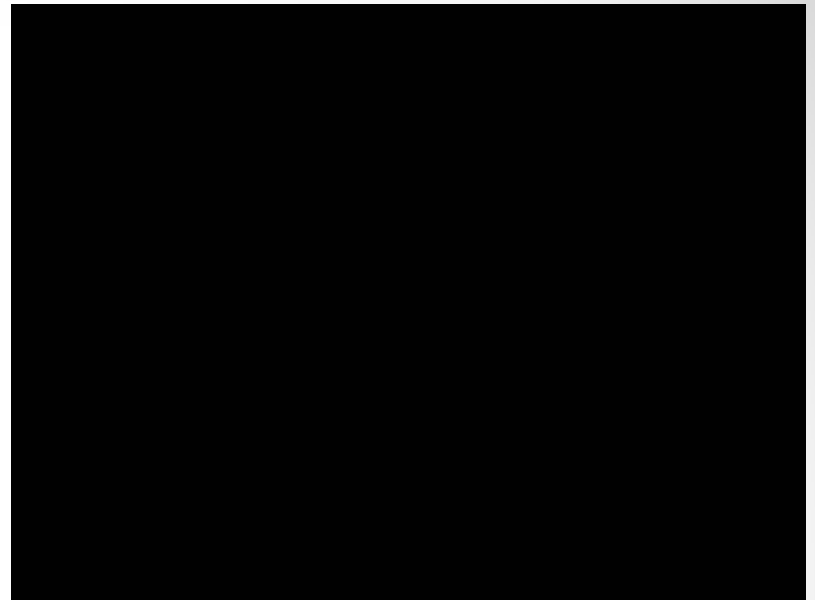
Criteria	Weight	Blade Cap	Solenoid Activated	Motor Activated
Ease of Integration	30	25	18	18
Ease of Use	25	22	20	17
Durability/Life Span	30	14	17	16
Capabilities	15	10	13	8
Cost	10	9	5	6
Totals:	100	80	73	65

Future Testing

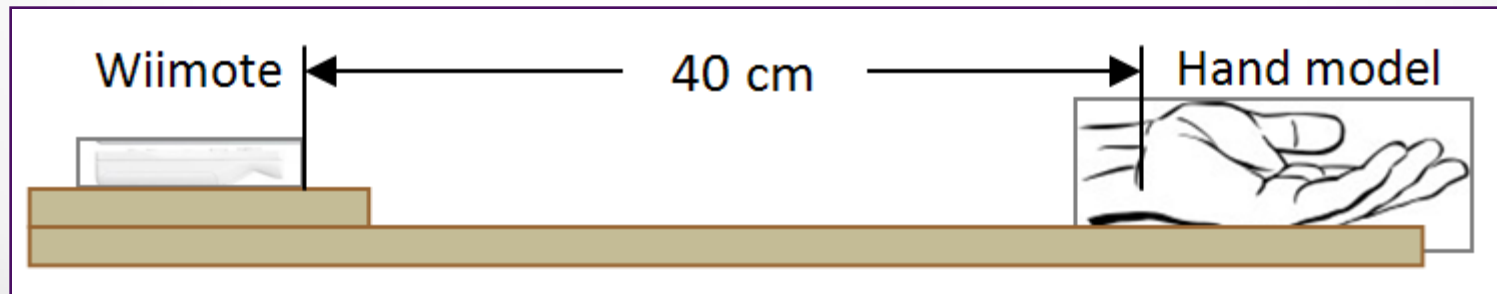


- Administer survey to surgeons
- Use feedback to optimize prototype
 - Size of ligament corrugations
 - Diameter of carpal tunnel
 - Magnitude of force feedback during 'cut'
 - Overall feel and aesthetics

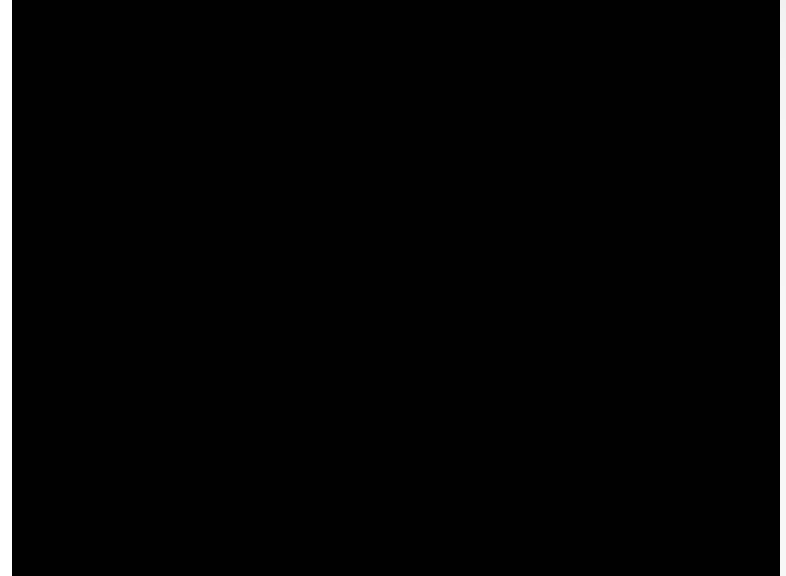
Future Work



- Sync tracking system with virtual environment
- Manufacture cover for circuit board
- Create platform to align testing system



Future Work



- Creation of a complete learning tool
 - Pictures and descriptions of surgical tools
 - Video of real-time surgery
 - Step-by-step instructions explaining procedure
 - Feedback from interactive questions

References

- [1] Vasiliadis, H., Xenakis, T., Mitsionis, G., Paschos, N., & Georgeoulis, A. (2010). Endoscopic versus open carpal tunnel release. *Arthroscopy*, 26(1), 26.
- [2] Williams, M. (2010). How does the Wii remote work? Retrieved from http://www.ehow.com/how-does_4895604_wii-remote-work.html.
- [3] Lee, J. (2008). Hacking the Nintendo Wii remote. *Pervasive Computing, IEEE*, 7(3), 39-45.
- [4] Zheng, Y., Li, Z., Chen, X., Lu, M., Choi, A., et al. (2006). Ultrasound palpation sensor for tissue thickness and elasticity measurement-assessment of the transverse carpal ligament. *Ultrasonics*, 44.
- [5] Chmarra, M. , Bakker, N. , Grimbergen, C. , & Dankelman, J. (2006). Trendero, a device for tracking minimally invasive surgical instruments in training setups. *Sensors and Actuators A-physical*, 126(2), 328-334.
- [6] www.igstk.org/IGST/img/Tracker-IJCARS-FindSubmission.pdf
- [7] "Actuators – Solenoids." Society of Robots, 2010. Retrieved 8 February 2011. http://www.societyofrobots.com/actuators_solenoids.shtml.
- [8] Tubular Solenoids General Catalogue. 4 May 2009. <http://www.transmotec.com>.

A pencil sketch of several hands raised in the air, with the word "Questions?" overlaid in blue text. The sketch is rendered in a light, sketchy style, showing the outlines and shading of the hands. The text is in a bold, sans-serif font, centered horizontally and slightly above the middle vertically. There are two small black dots at the bottom left and bottom right corners of the page.

Questions?