Textile sensor glove for health monitoring

Application in home assessment of Rheumatoid Arthritis

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Overview

- Introduction
- Textile Sensors
- Sensor glove
- Results
- Conclusions

CLARITY – SFI CSET

- **5-year, €16.4 million research program to develop next generation Sensor Web Technologies with significant focus on applications – environment, sports, health, agriculture, food**
- **Brings together fundamental materials science, functional polymers, device prototyping, energy management, adaptive middleware, wearable sensors, distributed environmental monitoring ….**
- **www.clarity-centre.org/**

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INTELLIGENT SYSTEMS RESEARCH CENTRE

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The Intelligent Systems Research Centre, ISRC,Faculty of Engineering, on the Magee College campus

Founded in 1997 and is currently composed of 30 academic staff and 28 research students

ISRC embraces the topic of intelligent systems in the widest sense; the activities of the group encompass research into a range of intelligent and hybrid technologies, and include work on neural networks, hybrid intelligent systems, internet technologies and computer networking.

Aim of project

Figure 1

Figure 2

Around 40,000 people in Ireland have the severe inflammatory auto-immune condition called rheumatoid arthritis (RA) where the body is said to attack itself. 70% of these rheumatoid arthritis patients are women.

Aim of project

Assessment of RA is done manually, is time consuming, subject to differences between observers

Develop a customised sensor glove, to measure hand movements

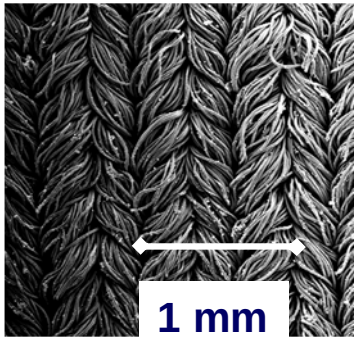
Continuous monitoring at home, carry out exercise routines defined by therapist

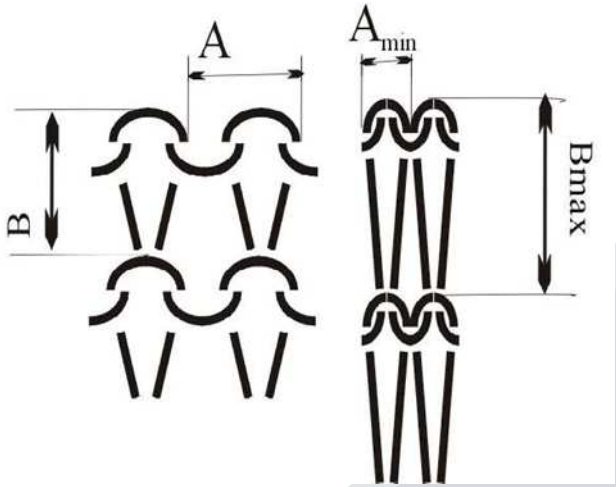
Easy to use computer interface, glove easy to wear

Textile Stretch Sensors

Piezoresistive fabrics – Change in resistance when a force is applied

Ppy Coated Lycra





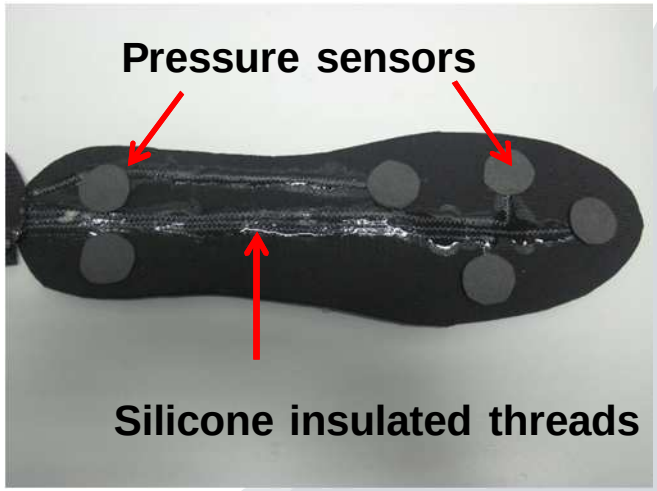
Coating with conducting polymer (e.g. Polypyrrole) makes the fabric conductive

When stretched more threads are in contact with each other giving a greater surface area for conductance

Stretching causes a decrease in resistance

Textile sensors

Breathing monitoring



Smart insole
Foot pressure monitoring

Textile Sensor Glove

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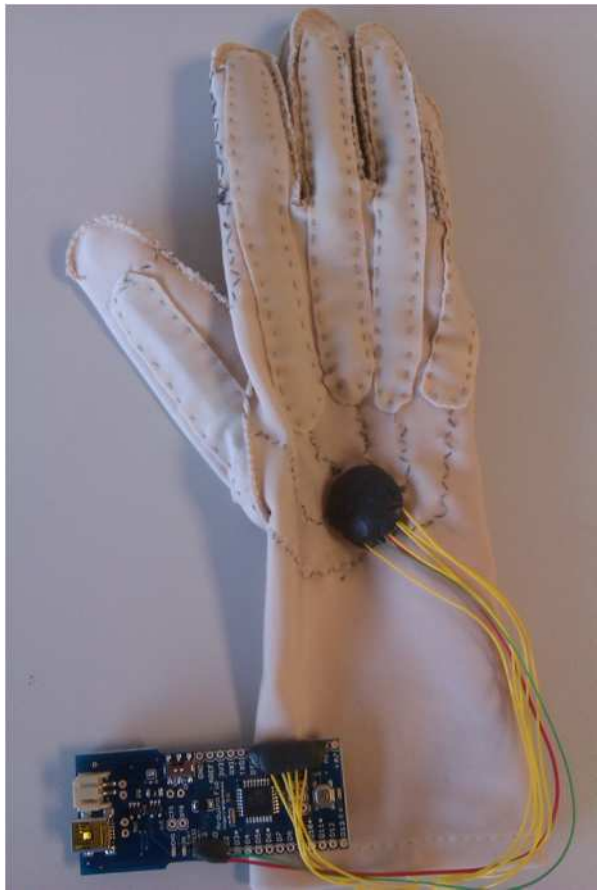
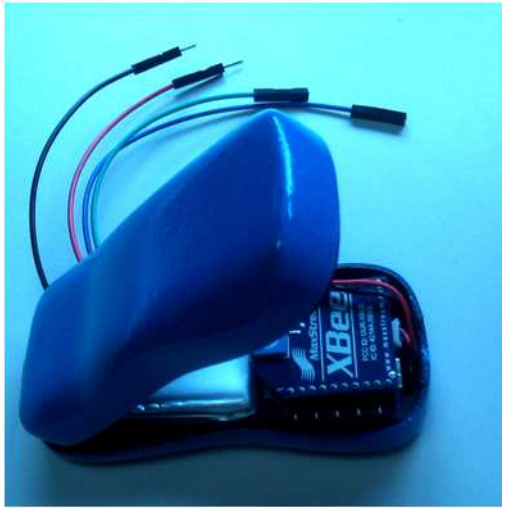
Fabric stretch sensor on each finger and thumb

Connected using conductive thread

Stitched to Lilypad Protoboard

Textile Sensor glove





Wired to Arduino Fio with Xbee radio

Cost
Sensors £10
Glove £15
Arduino £20
Xbee £20
Components £10
Total cost ~£75

Control Software

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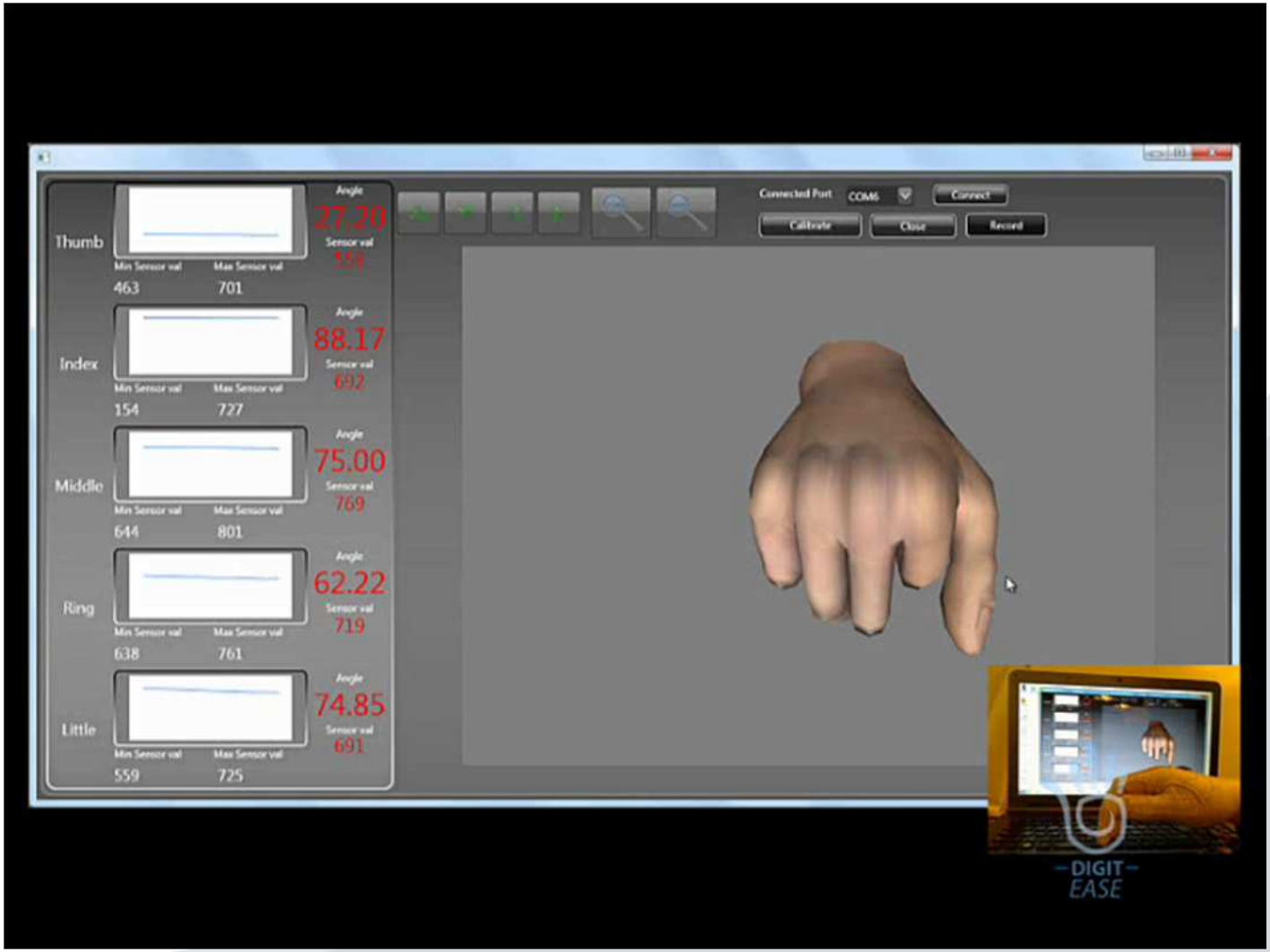


Evaluate performance – Comparison with 5DT Data Glove

5DT Data Glove 14 Ultra Commercially available virtual reality glove
http://www.5dt.com/

Fibre optic sensors

2 sensors per finger

Abduction between fingers.

$5500 for glove
$1500 for wireless kit

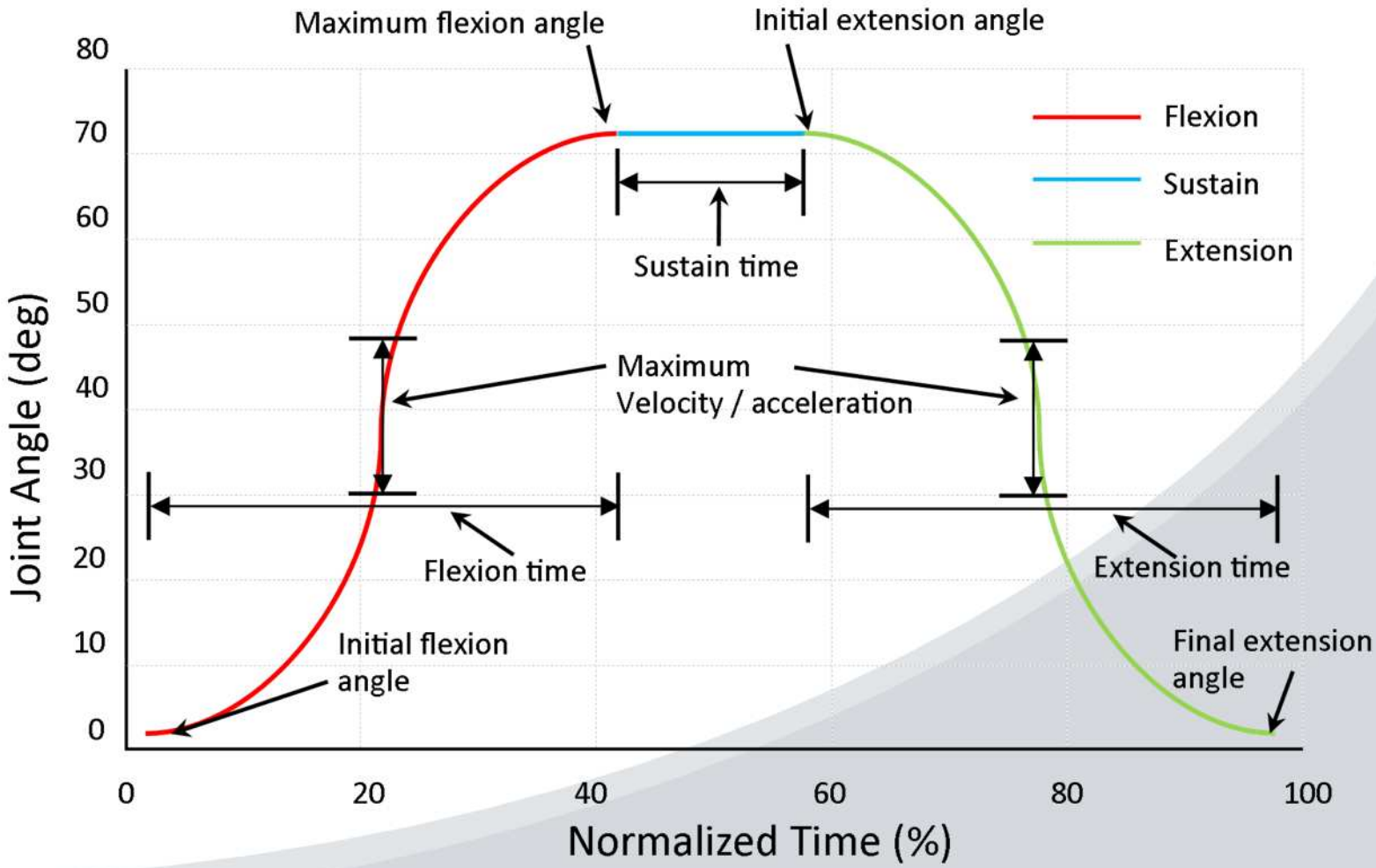
Comparison 5DT vs Textile Glove

Both gloves worn on same hand and connected to 2 computers running same controlling software

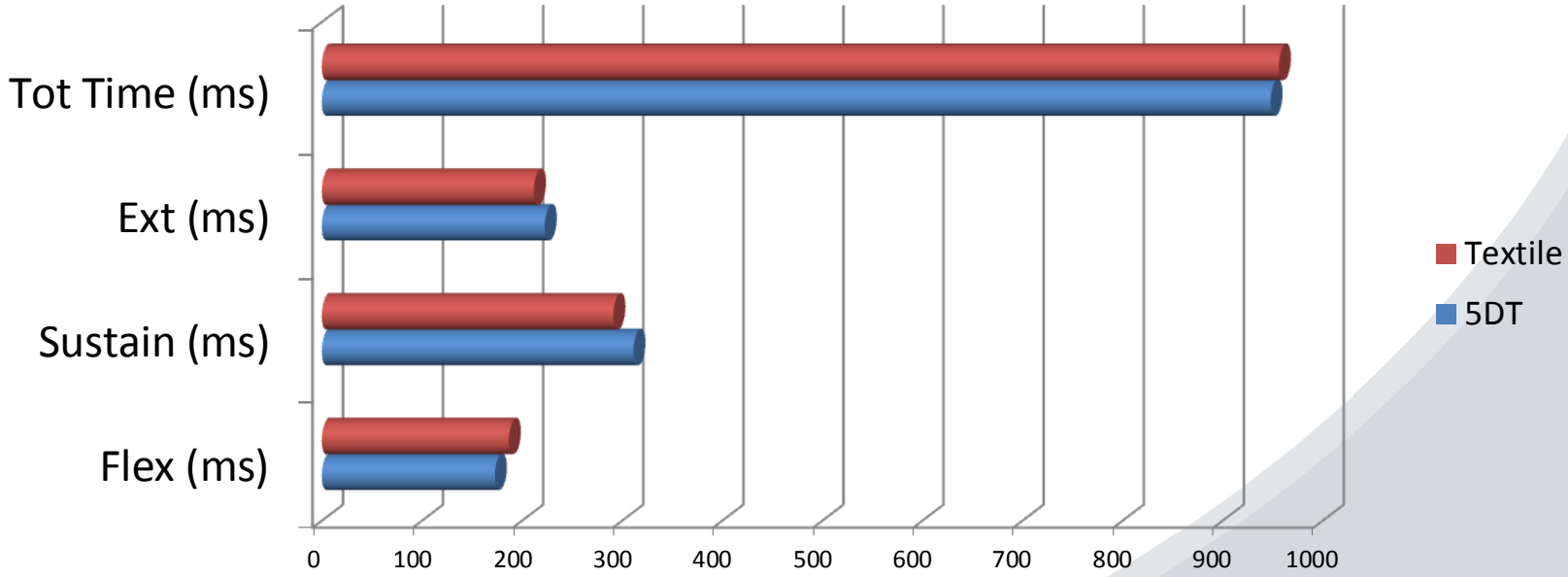
An objective routine was performed consisted of 12 flexion and extension repetitions that measured movement of the middle metacarpophalangeal (MCP) finger joint.

The first repetition was used to synchronise recordings between computers. Data sampled every 25ms

Comparison 5DT vs Textile Glove

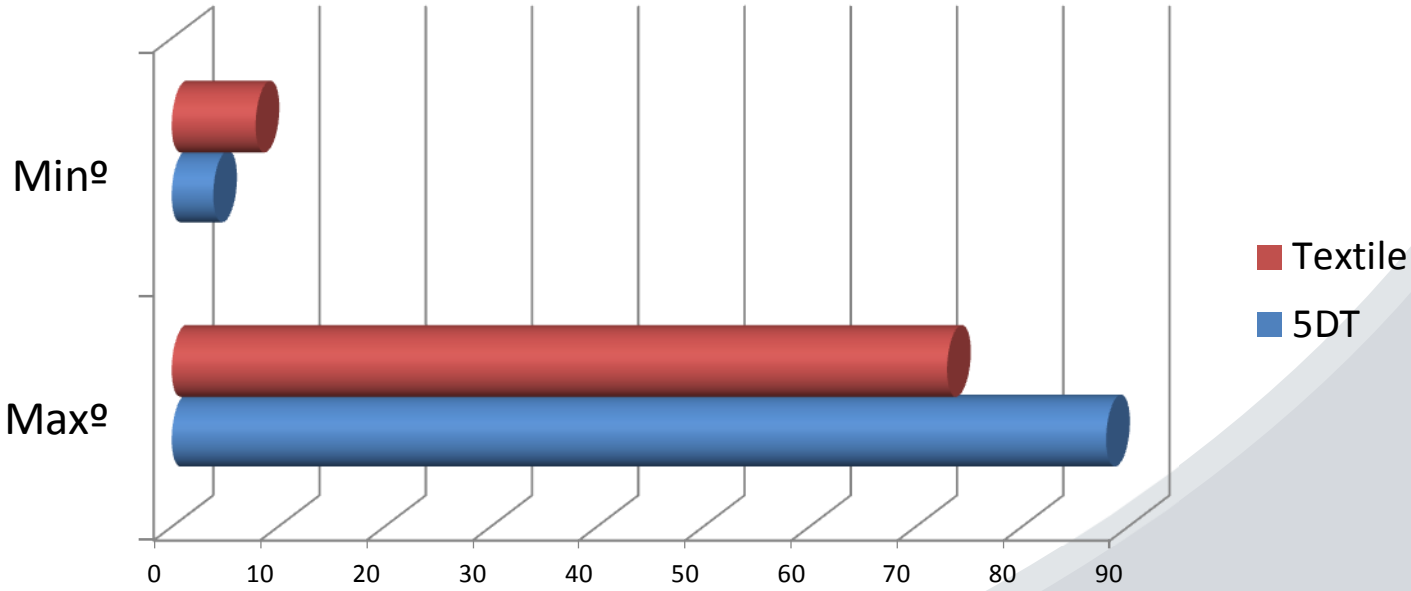


Results



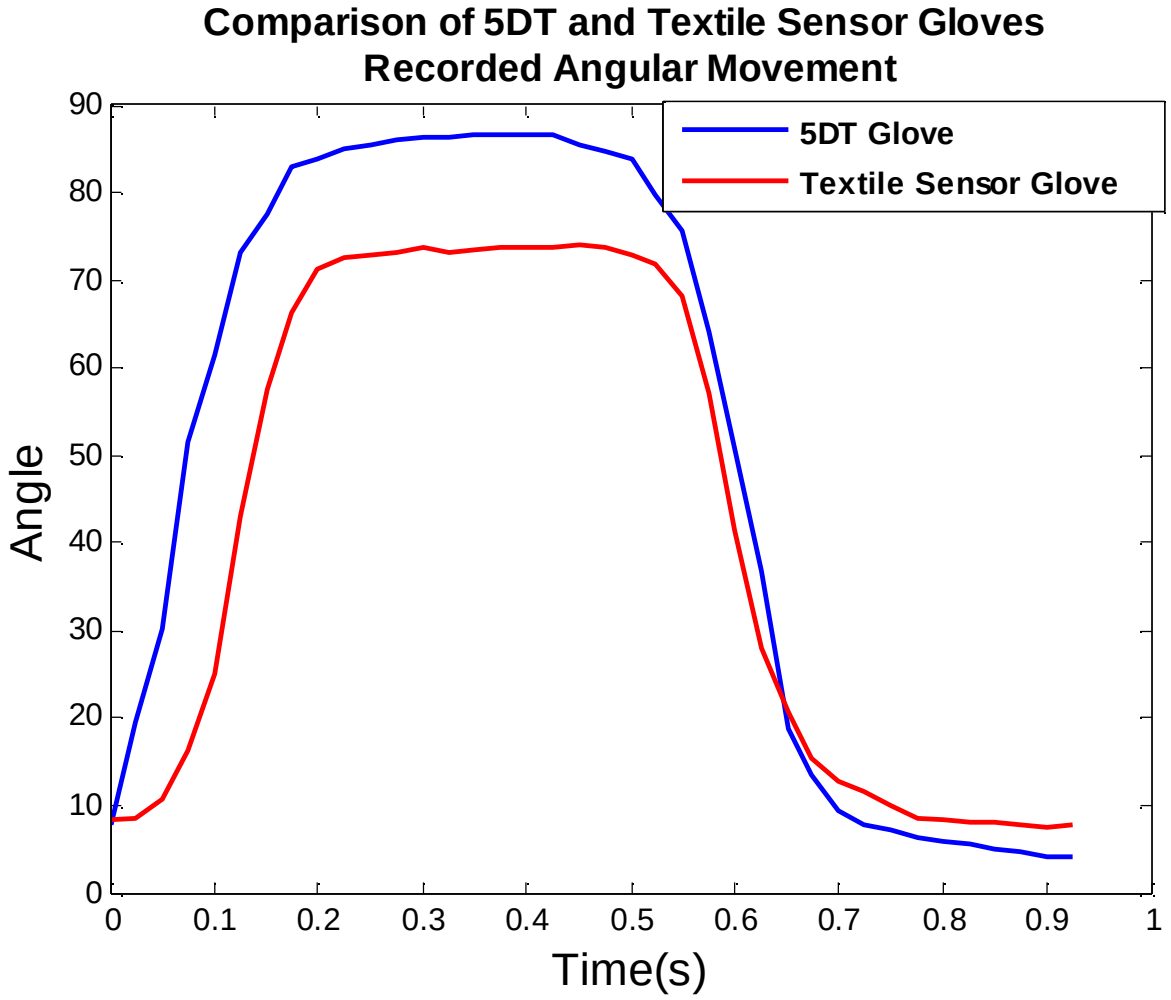
Comparison of average timing measurements from 5DT and Textile Sensor Glove

Results



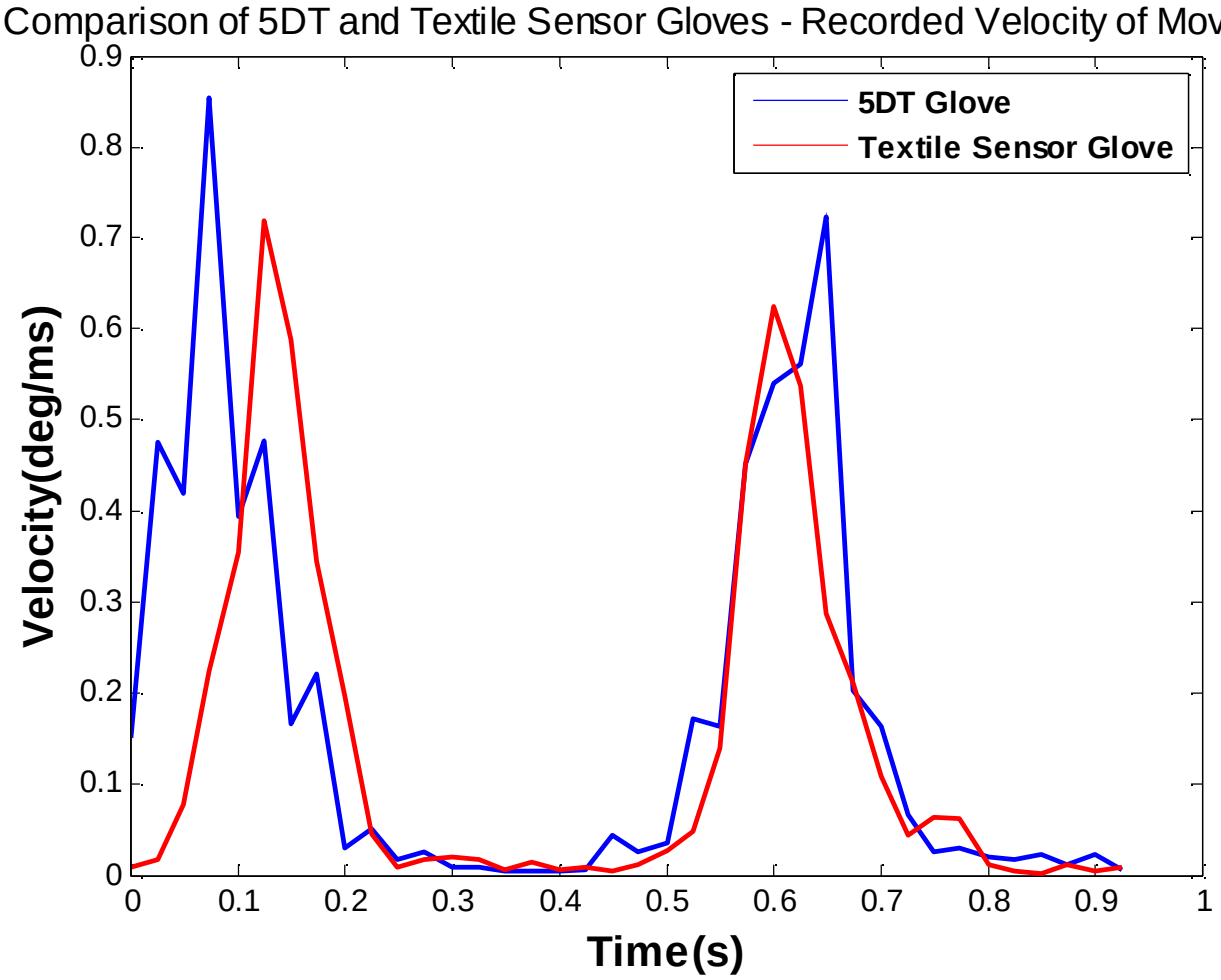
Comparison of average max and min angle measurements from 5DT and Textile Sensor Glove

Results



Correlation
r=0.96

Results


Comparison of 5DT and Textile Sensor Gloves - Recorded Velocity of Movement
5DT Glove
Textile Sensor Glove
Velocity(deg/ms)
Time(s)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Challenges

Fit and Sensor placement

Challenges

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Calibration -

Limited range of movement

Changes in swelling day to day will affect fit

Future work

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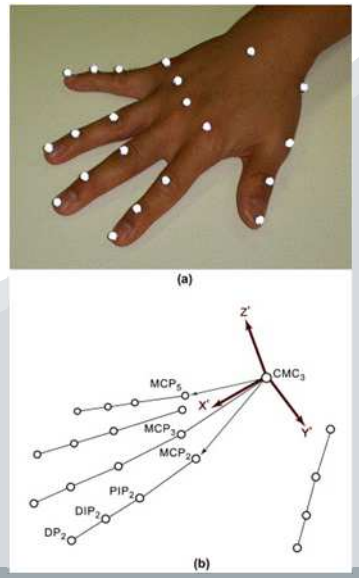
- 2 sensors per finger
- Accelerometer and gyroscope
- Investigate plastic optic fibre sensors
- Comparison with Vicon motion capture system

Triple Axis Accelerometer & Gyro Breakout - MPU-6050



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Thank You !