



Mobile Gait Analysis for Lower Limb Prostheses.

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Current practice in gait analysis lower limb prosthetics

- Gait Analysis allows optimal alignment
- Visual gait analysis in clinical setting and other terrain
- Instrumented Gait Analysis in Gait Lab

Challenges for current gait analysis methods

- Visual Gait analysis not repeatable
- Instrumented Gait analysis only in Gait Lab
- Instrumented Gait analysis compromised by abnormal anatomy.

Aim of Pilot Study

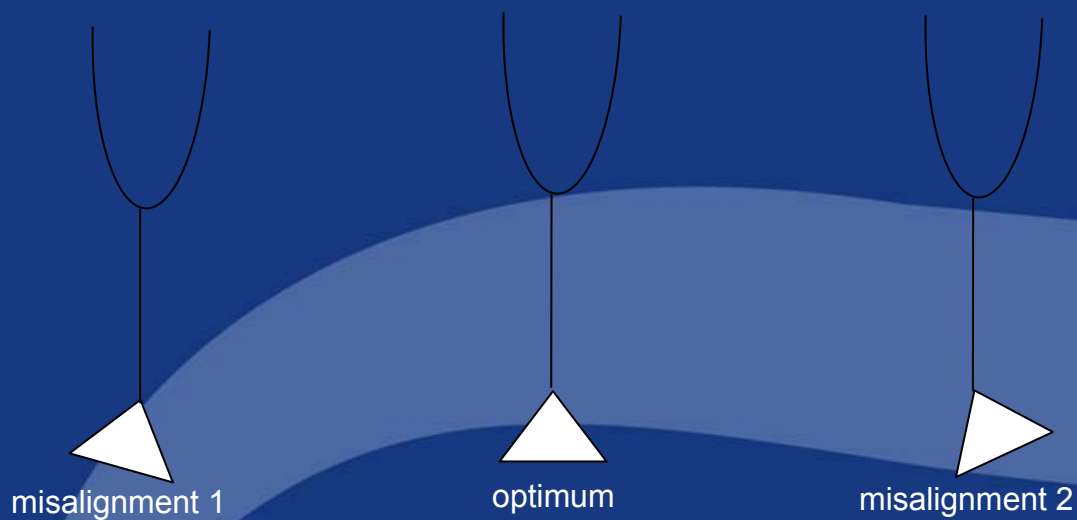
- Determine practicality of using speckled technology
- Determine whether clinically useful information could be obtained on a variety of terrain
- Determine whether changes in Prosthetic alignment could be detected

Results GL6

- Right TT amputee.
- PTB socket with Multiflex Foot
- Data collected in three different alignments

Results - GL6

- Alignment changes



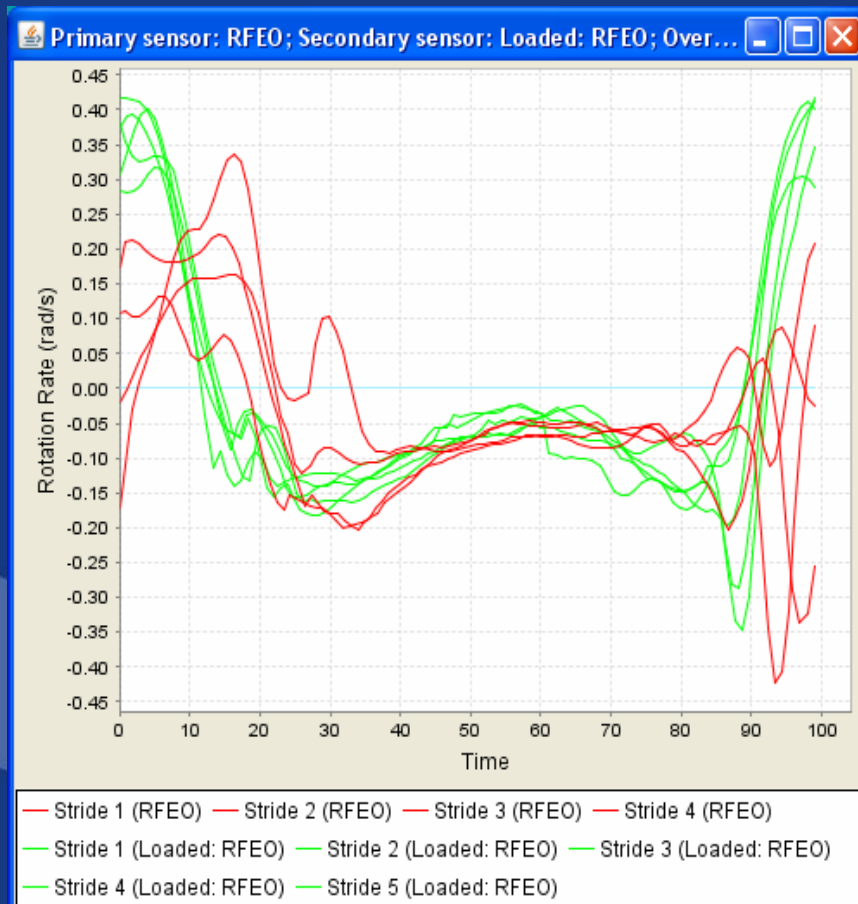
Results GL6

- Difficult to observe changes visually
- Speckled technology did detect changes
- Particularly notable in shin data
- Suggests specks could be developed to aid prosthetic alignment

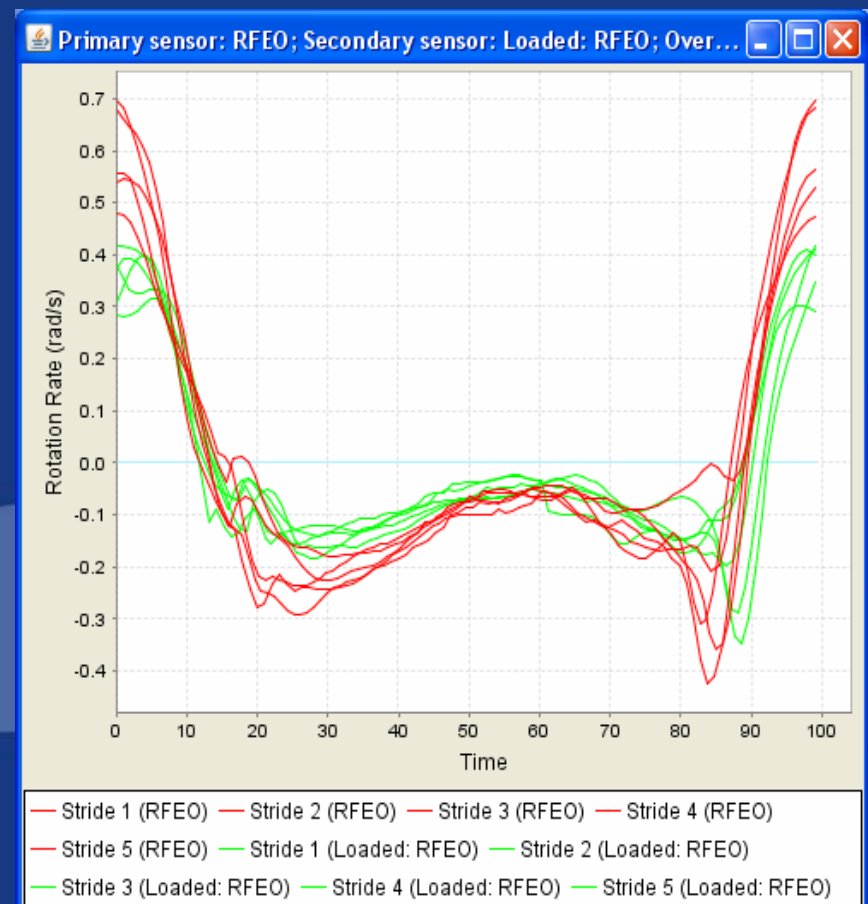
GL6 Coronal plane data from right shin speck
 Red = misalignment
 Green = optimum alignment



Misalignment 1



Misalignment 2



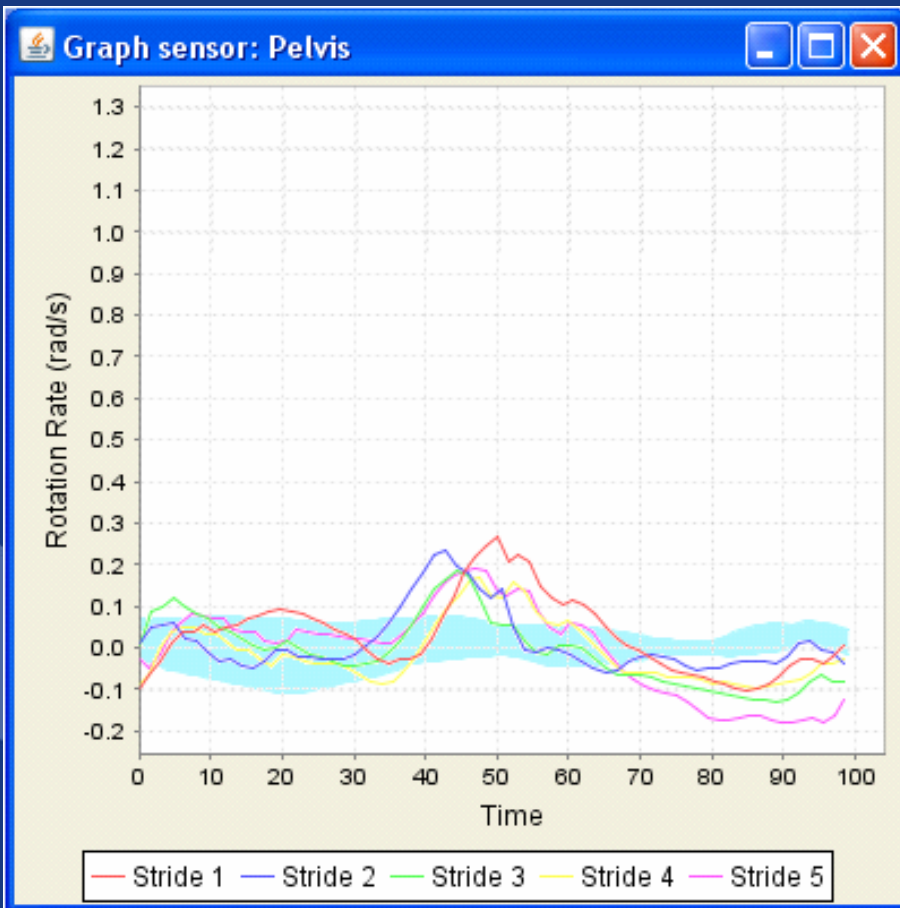
Results GL4 Indoor/Outdoor Area

- Sagittal plane data from bilateral amputees compared with normal values
- Flat surface and slope
- Timing differences between normal and amputee gait
- Greater deviations from normal values on challenging terrain

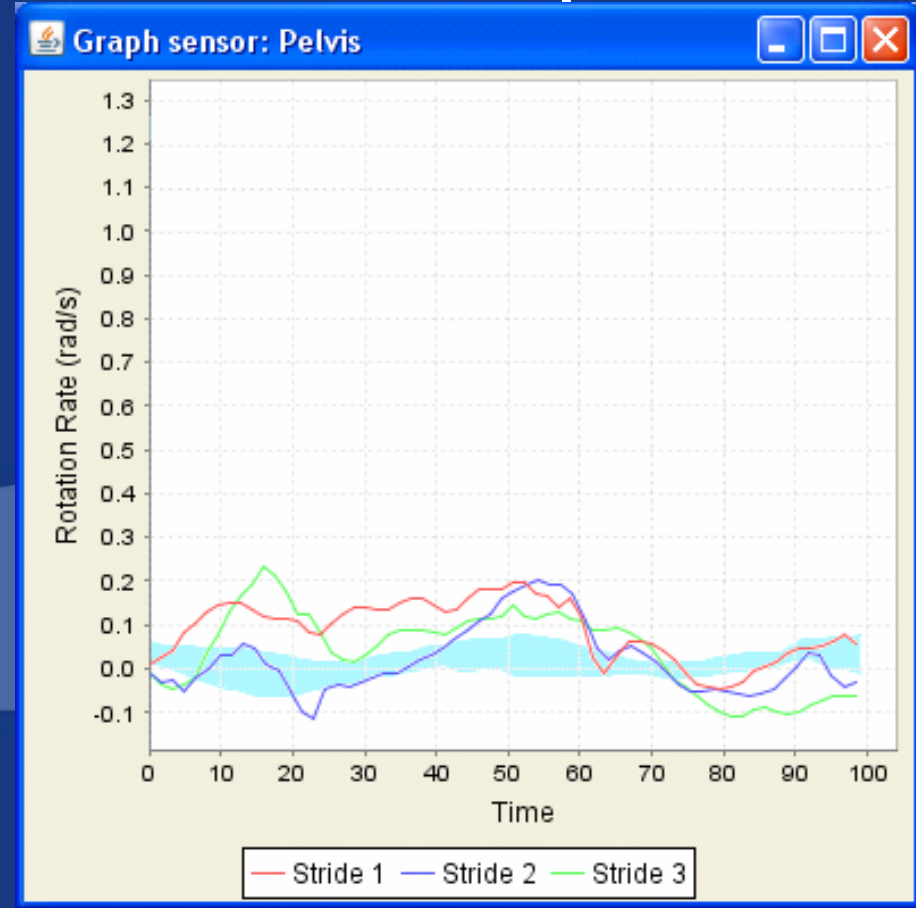
GL4 Indoor/Outdoor Area Bilateral trans-tibial amputee



Flat & level surface



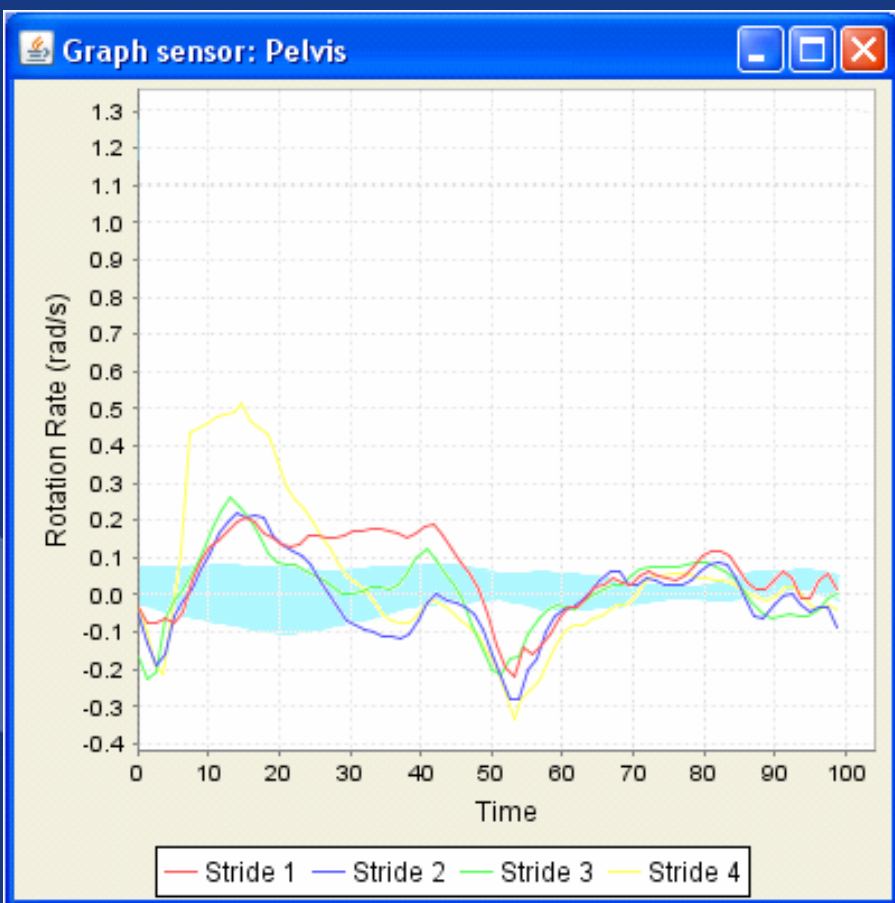
Down slope



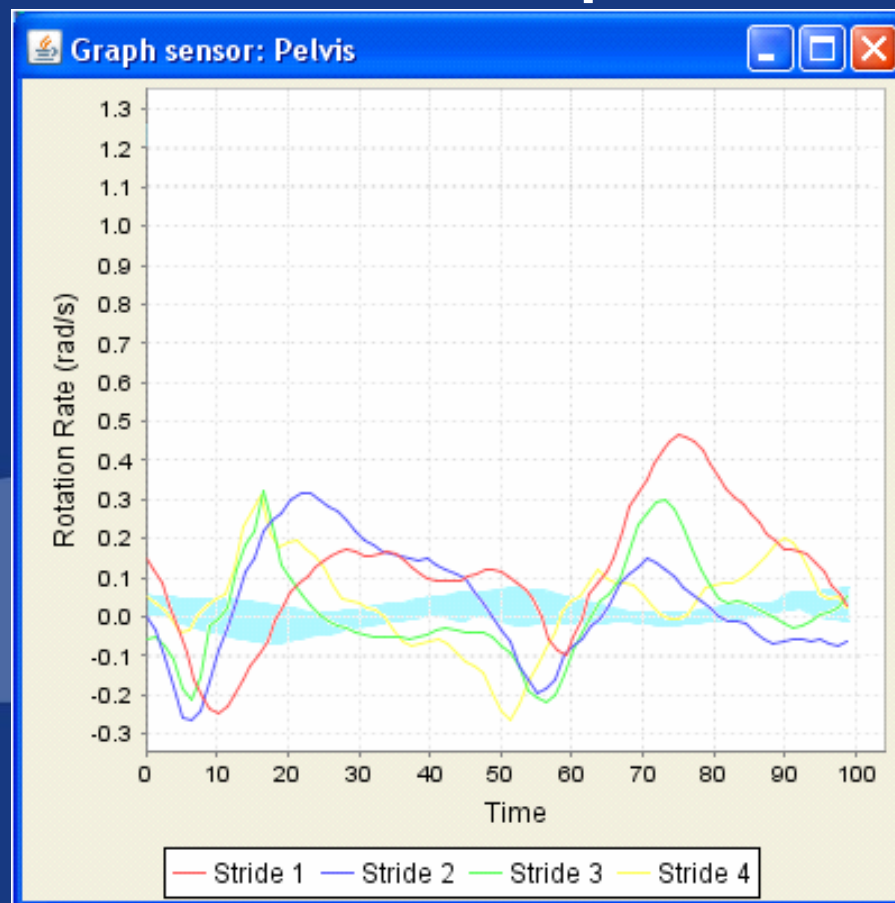
GL5 Indoor/Outdoor Area Bilateral trans-tibial amputee



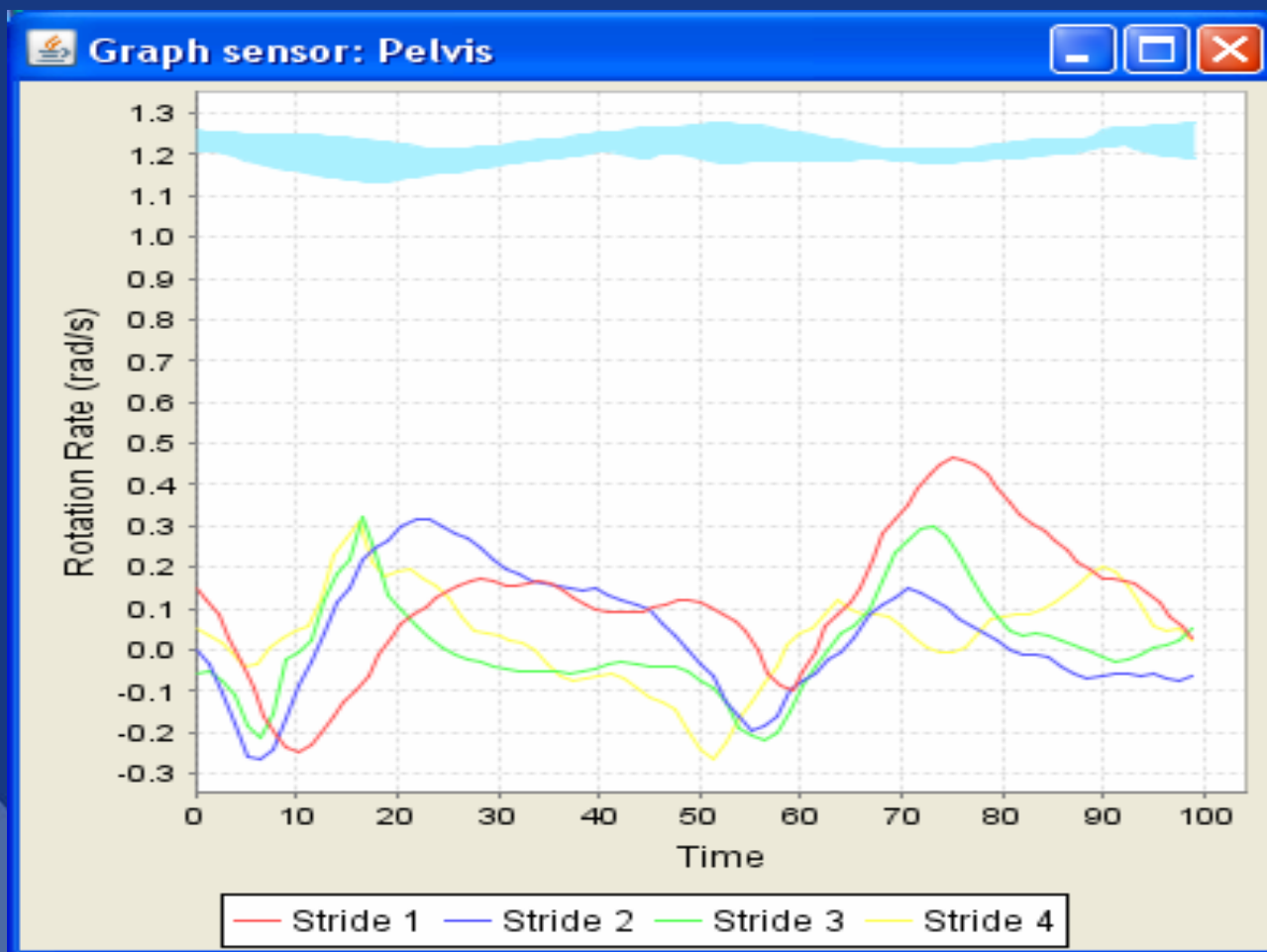
Flat & level surface



Down slope



Technical problems!



Results GL7

- Established amputee with a right side trans-femoral amputation
- Catech knee, Seattle prosthetic foot and torque absorber
- Misalignment1 with the prosthetic limb 1.5cm too long
- Misalignment2 with the prosthetic knee in increased external rotation

GL7 Misalignment 1

Red = Alignment 1.5 cm too long

Green = Optimum alignment

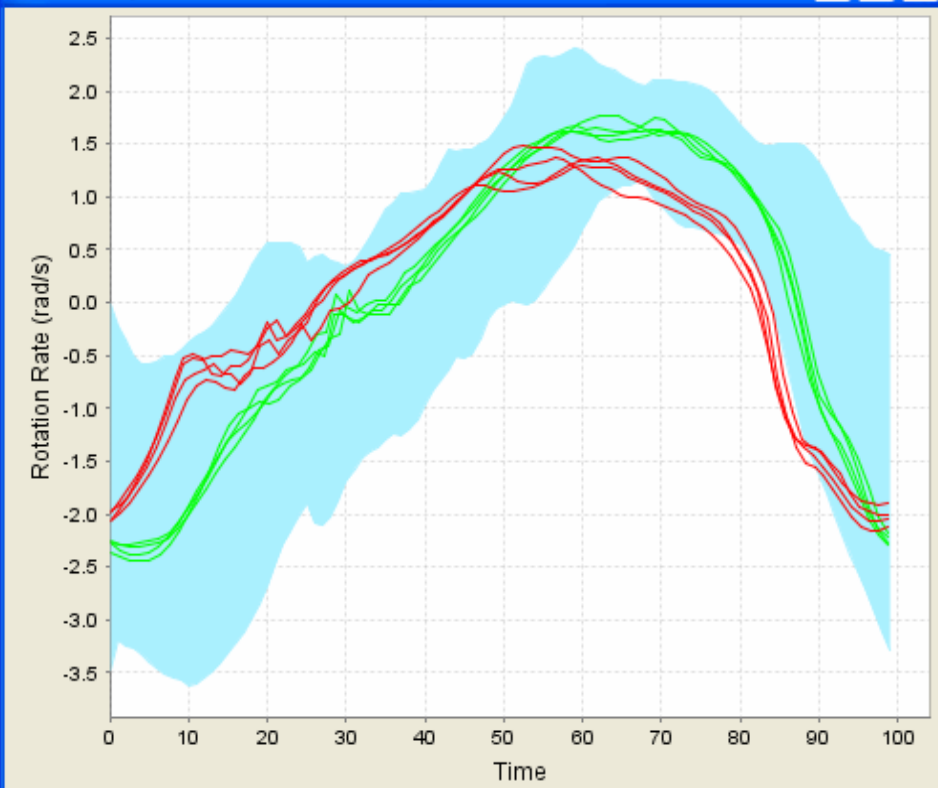
Light blue = normal



Left Thigh (Sound)

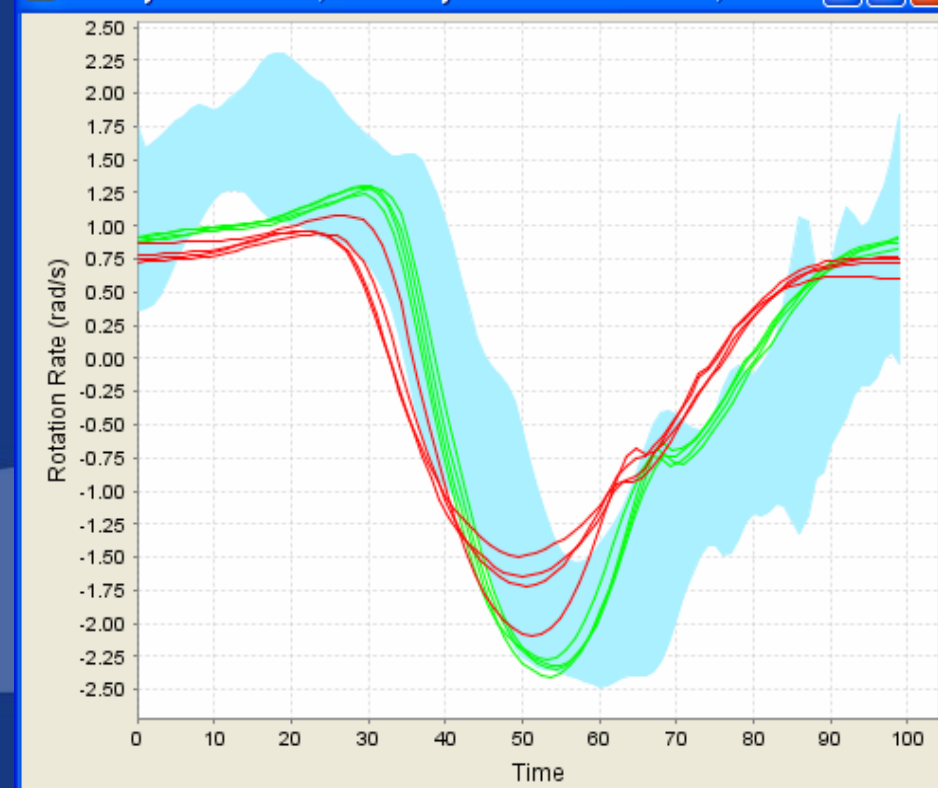
Right Thigh (Prosthetic)

Primary sensor: LFEP; Secondary sensor: Loaded: LFEP; Overl...



— Stride 1 (LFEP) — Stride 2 (LFEP) — Stride 3 (LFEP) — Stride 4 (LFEP)
— Stride 1 (Loaded: LFEP) — Stride 2 (Loaded: LFEP) — Stride 3 (Loaded: LFEP)
— Stride 4 (Loaded: LFEP)

Primary sensor: RFEP; Secondary sensor: Loaded: RFEP; Overl...



— Stride 1 (RFEP) — Stride 2 (RFEP) — Stride 3 (RFEP) — Stride 4 (RFEP)
— Stride 1 (Loaded: RFEP) — Stride 2 (Loaded: RFEP) — Stride 3 (Loaded: RFEP)
— Stride 4 (Loaded: RFEP)

GL7 Misalignment 1

Red = Alignment 1.5 cm too long

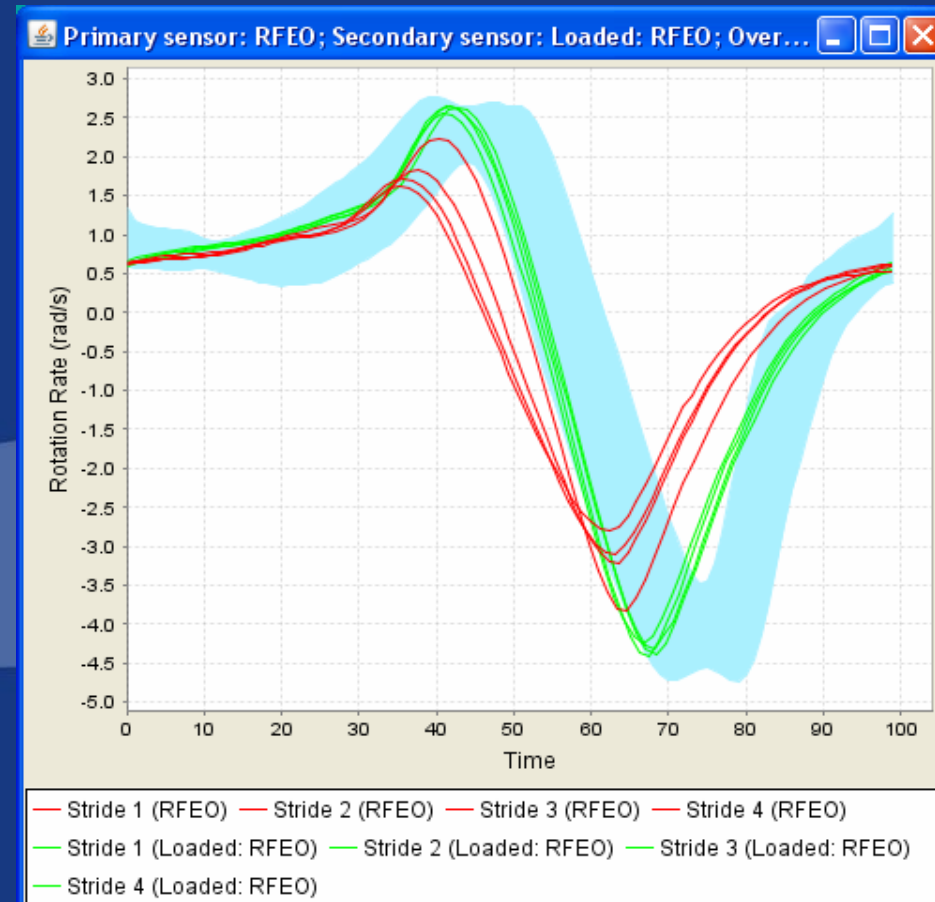
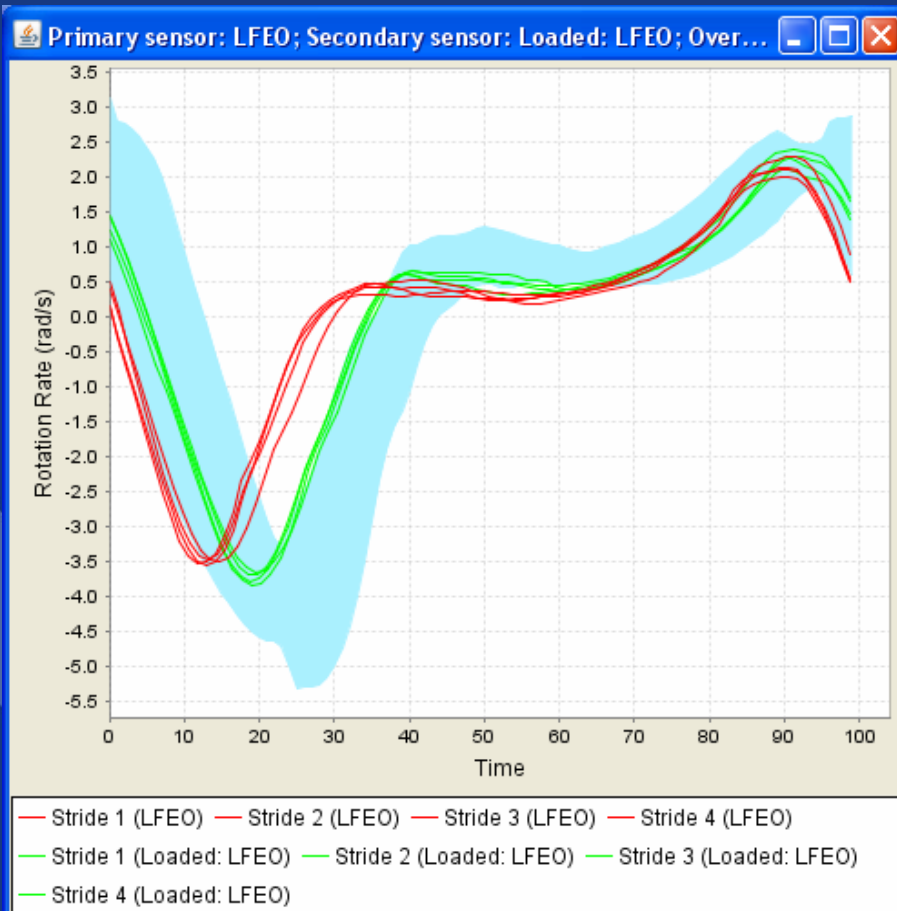
Green = Optimum alignment

Light blue = normal



Left shin (Sound)

Right shin (Prosthetic)



GL7 Misalignment 2

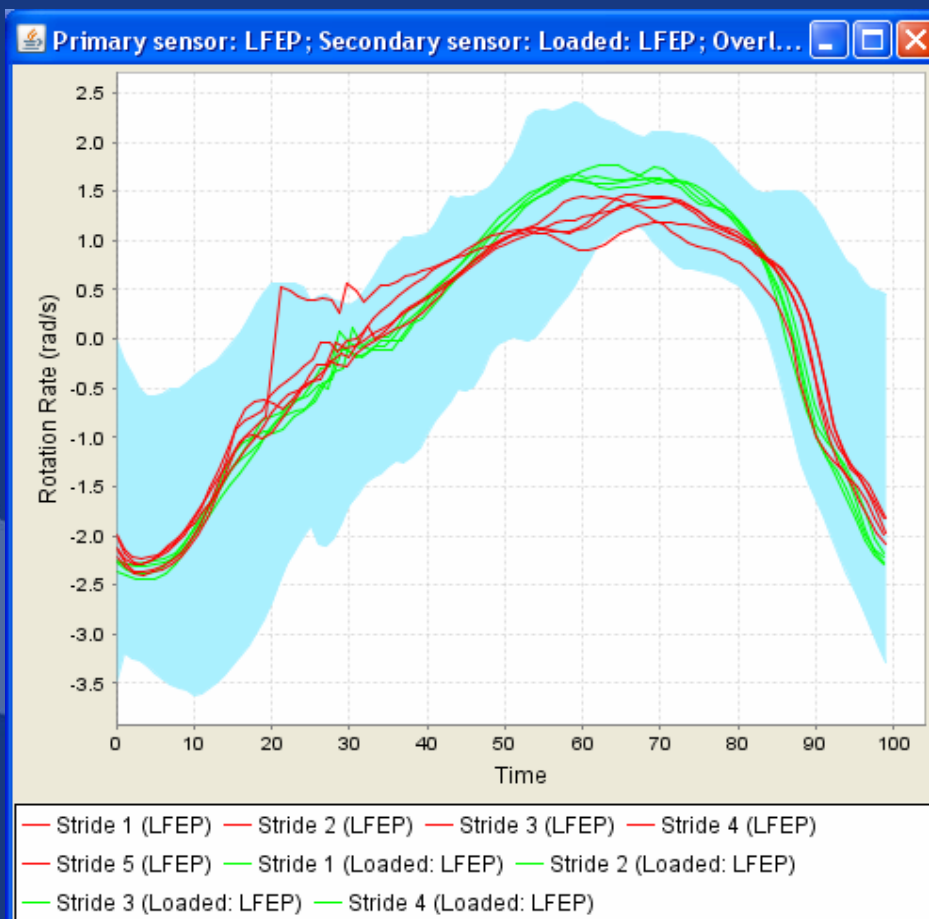
Red: alignment with \uparrow external knee rotation

Green: optimum alignment

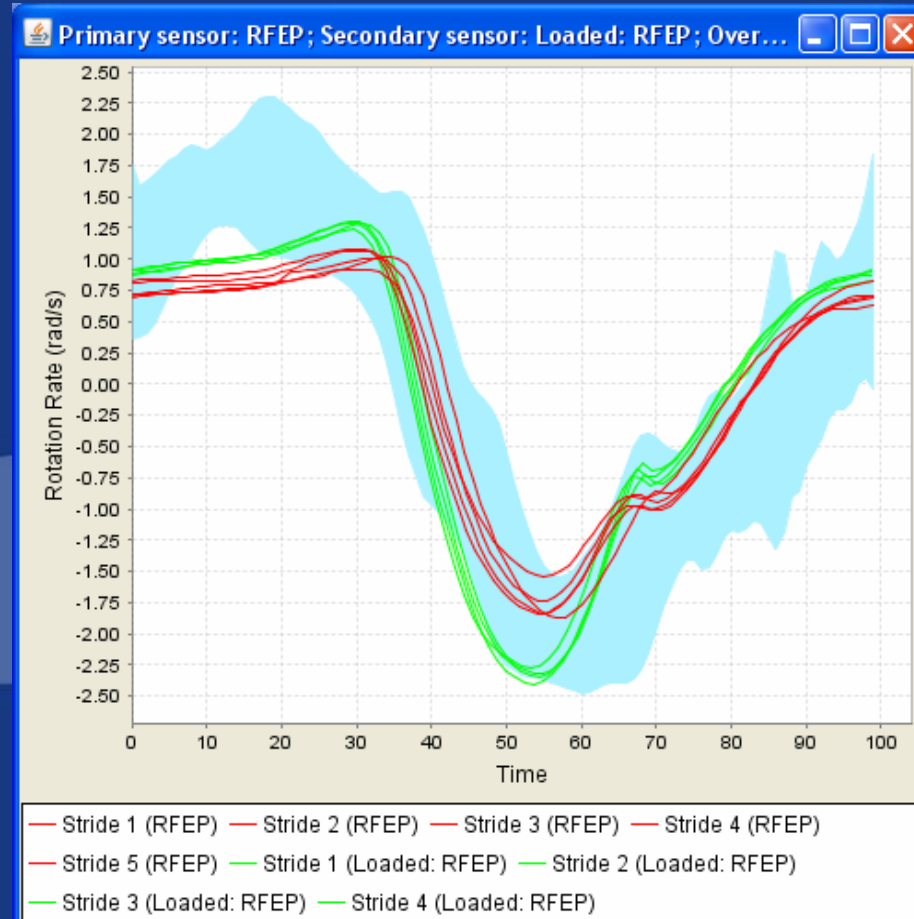
Light blue: typical normal



Left Thigh (Sound)



Right Thigh (Prosthetic)



GL7 Misalignment 2

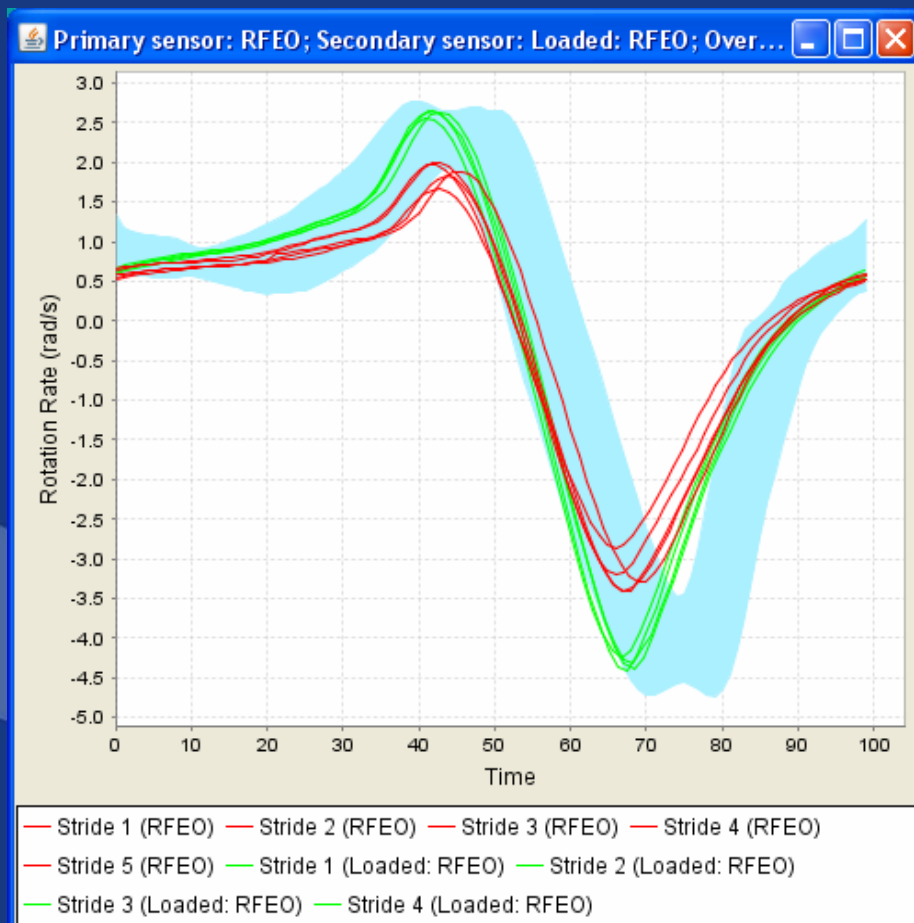
Red: alignment with \uparrow external knee rotation

Green: optimum alignment

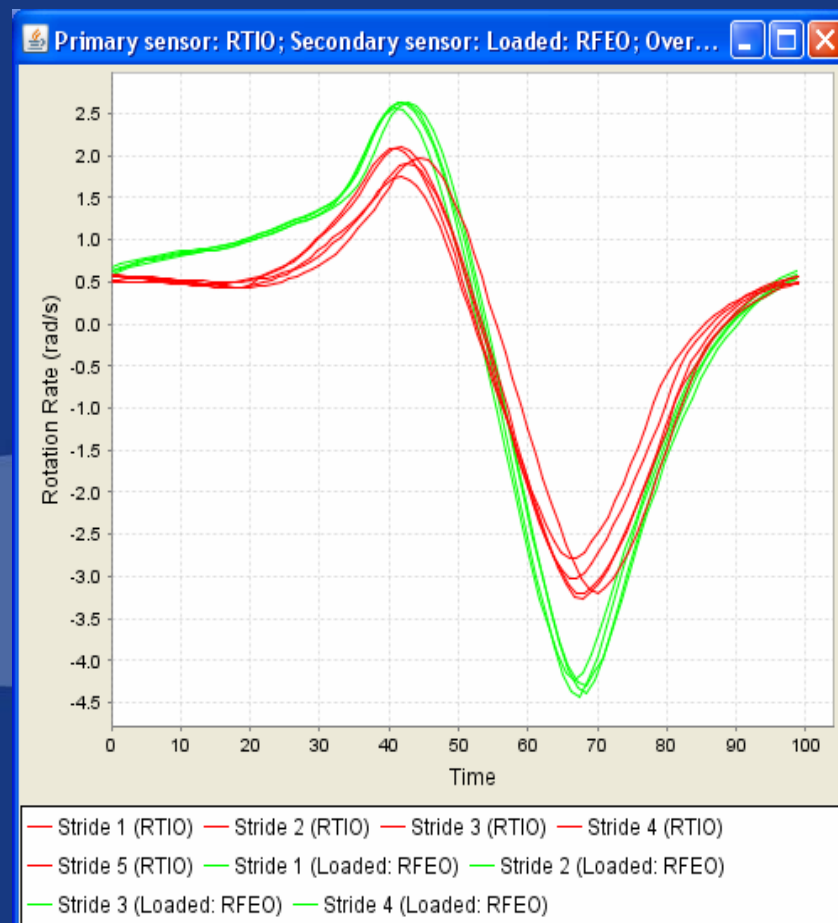
Light blue: typical normal



Right Shin (Prosthetic)



Right Foot (Prosthetic)



Conclusion

- Speckled Technology has potential benefits over currently used methods of gait analysis.

Potential Benefits

- Less time consuming than current instrumented methods
- Requires less expertise in placement of markers/specks
- Not affected by abnormal anatomy
- Sensitive enough to detect clinically significant change
- Can be used in many environments

Further Developments

- Timing information
- Quick and easy interpretation of data
- Robust method of attaching specks



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