

International Collaboration and Capacity Building in Southeastern Asia: Spreading Human Motion Analysis Techniques and Technology

Ryan Inawat^{1,2}, Jeffrey Kertis MS^{1,2}, Karl Canseco MD², and Gerald Harris PhD, PE¹⁻³

¹Department of Biomedical Engineering, Marquette University, Milwaukee, WI

²Orthopaedic and Rehabilitation Engineering Center (OREC), Marquette University/Medical College of Wisconsin, Milwaukee, WI

³Departments of Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI and Shriners Hospital for Children, Chicago

Background

- Human motion analysis allows quantitative assessment of the upper and lower extremities:
 - Joint motion (kinematics)
 - Forces (kinetics)
- Data acquired through motion analysis has proven useful in a variety of clinical settings:
 - Pediatric rehabilitation
 - Orthopaedics
 - Sports medicine
 - Prosthetics and orthotics
- Despite utility of motion analysis technology, implementation of motion analysis labs in southeastern Asia is hindered by:
 - High Cost (\$50K-\$300K)
 - Number of necessary staff

Collaboration

- OREC has developed a low-cost clinical motion analysis system (~\$20K):
 - Precise and accurate motion capture
 - Needs minimal staff: a technician and a clinician
- Desire to promote utilization of motion analysis and international collaboration in pediatric rehabilitation and orthopaedic research has led to a partnership between:
 - The Orthopaedic And Rehabilitation Engineering Center (OREC)-affiliated with Marquette University and the Medical College of Wisconsin
 - University of the Philippines-Philippine General Hospital (UP-PGH)

Low-Cost Motion Analysis System

- The Motion Analysis Program of the Philippine General Hospital, Department of Orthopedics (PGH ORTHO MAP) uses the following hardware and software to perform motion analysis:
 - Twelve (12) Flex13 Cameras (NaturalPoint, Oregon, US)
 - Two (2) OptiHub2 Camera synch hubs (NaturalPoint)
 - AMASS (C-Motion, Maryland, US)
 - Visual3D (C-Motion)
- Validation performed by Kertis et al. showed a minimum accuracy of 94.82% and minimum resolution of 0.63±0.15 mm when performing static and dynamic calibration.



Table 1: Accuracy and Resolution during static and dynamic calibration

	Static	Linear Dynamic	Angular Dynamic
Minimum Accuracy (%)	99.31	95.59	94.82
Maximum Accuracy (%)	99.90	99.77	99.68
Minimum Resolution (mm)	0.63± 0.15	0.37± 0.23	0.61± 0.31
Maximum Resolution (mm)	0.04± 0.15	0.05± 0.21	0.10± 0.19

- A standardized gait report was developed depicting pelvis, knee, hip and ankle kinematics in the sagittal, coronal, and transverse planes. This is similar to gait reports used in motion analysis labs to determine intervention strategies for gait deviations.

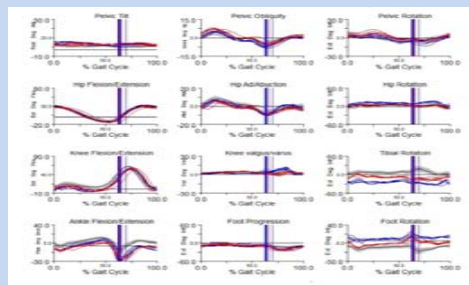


Figure 1: Gait Kinematics Report

Implementation

- A previous installation in Cali, Colombia showcases the feasibility of a motion analysis lab supported by two personnel
- The PGH ORTHO MAP will initially focus on using motion analysis to assist determining intervention strategies for patients with cerebral palsy and to perform gait related research.



Figure 2: General set-up of OptiTrack System

Evolution of Partnership

- Incremental increase in technologies (electromyography, force plates) will allow monitoring of joint forces and muscle activation during motion analysis
- Expansion of database accessible to both OREC and PGH for collaborative research on pediatric gait disorders

References/Acknowledgements

Kertis, Jeffrey D., et al. "Static and Dynamic Calibration of an Eight-Camera Optical System for Human Motion Analysis." *Critical Reviews & Trade; in Physical and Rehabilitation Medicine* 22.1-4 (2010): 49-59
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