Evaluating the accuracy and reliability of smartphone photogrammetry for scanning residual limbs

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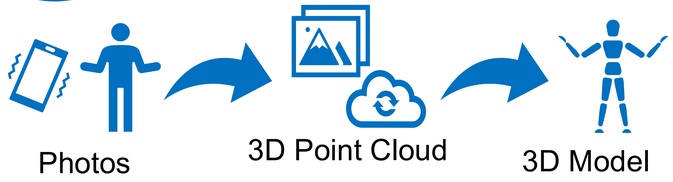
Background



Smartphone Photogrammetry Process

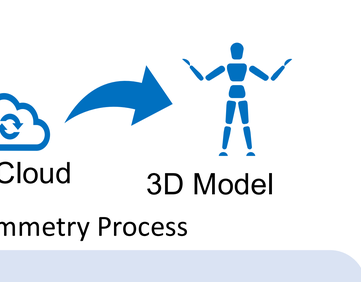
Smartphone photogrammetry may be an **at-home method** for scanning residual limbs, but there is minimal research on its **accuracy and reliability.**

Main Objective

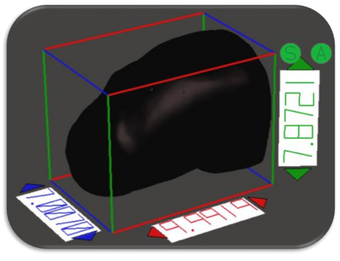
To evaluate the accuracy and reliability of three smartphone photogrammetry applications **(KIRI Engine, RealityScan, RealityCapture)**, compared to a gold standard, **clinically used 3D scanner** (EinScan, Shining Technologies, China)

Methods

Two users scanned **3 limb casts, 3 times,** with each app and the scanner while being timed.



Scanning Process



MeshMixer Process

MeshMixer was used to find **volume** and **dimensions** of the models.

MATLAB was used for evaluating data to find the **difference,** between the scanner and apps, and **ICC values to determine reliability.**

- Scanner → **2%, or 2mm accuracy**
- App 1 Trial 1 / App 1 Trial 2 → **ICC = 0.99**

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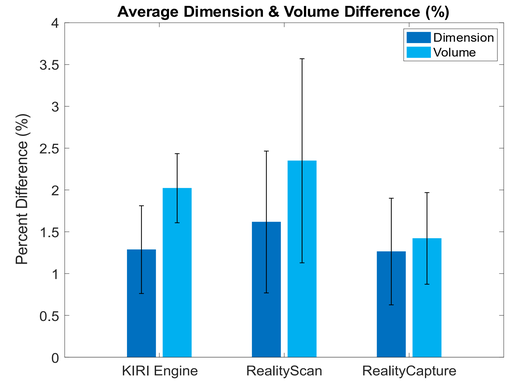
Getting a prosthetic is time-consuming, smartphone photogrammetry may be **a solution.**

Results & Discussion

Dimension difference of **less than 2mm (<2%)** and a volume difference of **less than 4%.** → **Clinically acceptable** difference values in terms of accuracy [1,2].

ICC values between **0.992 and 1.000.** → ICC values show apps are **extremely reliable** [1].

Total scan time of **less than 5 minutes**. / Total processing time of **less than 20 minutes**. → The scanner's overall time is **less than 3 minutes,** but it's only available at the hospital.



Next steps involve testing with...
- Darker objects
- Moving subjects
- Actual residual limbs

Relevance

If shown to be accurate and reliable, clients may be able to have their limbs **scanned at home.**

This will **save clients time and energy** that would be spent traveling to a prosthetist.

References: [1] C. C. Ngan, H. Sivasambu, S. Ramdial, and J. Andrysek, "Evaluating the Reliability of a Shape Capturing Process for Transradial Residual Limb Using a Non-Contact Scanner," *Sensors*, vol. 22, no. 18, p. 6863, Sep. 2022, doi: https://doi.org/10.3390/s22186863.
[2] A. Hernandez and E. Lemaire, "A smartphone photogrammetry method for digitizing prosthetic socket interiors," *Prosthetics and Orthotics International*, vol. 41, no. 2, pp. 210–214, Sep. 2016, doi: https://doi.org/10.1177/0309364616664150.