# Critical Anthropometric & Ergonomic Elements for Reliable Hand Placement in Hand Geometry Based Authentication System

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### **Motivation**

- Current hand geometry biometric devices work well with the majority of individuals, but are problematic with subsets of the population such as the elderly, individuals with MSDs, or missing digits (Figure 1).
- ✓ Literature search has yielded little work in the area related to human factors with

#### Hypothesis

✓ Ergonomics can affect the performance of the biometric system whose output is not Boolean, i.e. a password, but rather as a score. Suppose a biometric sample (hand image) is acquired and denoted as *h* and *h*' for two independent samples collected from the same individual at different times. After the hand geometry system processes the images *h* and *h*' you get:

regard to biometric device design.

 Provide an ergonomically designed biometric device that includes an examination on critical anthropometric and ergonomic elements to improve hand placement and resulting performance for a hand geometry device. This area of research called Human Biometric Sensor Interaction (HBSI) is a new topic of interest in the biometric community.



Figure 1. Example of a "normal" user (left) and a problematic user with a partial missing digit (right).

h = f(h) and h' = f(h')

However variability in the actual subjects over time causes variability in the samples, thus we indicate h and h' being functions of time:

h = h(t) = f(h(t)) and h' = h'(t') = f(h'(t'))

✓ Biometrics differentiate between individuals by computing scores, *s(h, h')*, or probabilities, *Prob(h≡h')*. As this is a function of *t*, the argument can be written as: s(h',h) = s(h'(t'),h(t)) = s(f(h'(t')),f(h(t)))

✓ However score is also dependent upon the repeatability of images, which is a function of hand placement, and thus impacted by ergonomics, e. s(h',h) = s(h'(t',e'),h(t,e)) = s(f(h'(t',e')),f(h(t,e)))

#### **Expected Outcome**

Integrating anthropometric and ergonomic elements into the design of a hand geometry device would minimize unneeded stressors on the hand and wrist, simplifying the way individuals interact with the hand geometry device, and maximizes repeatability of hand placement, allowing for a broader range of individuals to use the device, ultimately affecting system performance.

## Methodology

- Utilizes both qualitative and quantitative methods
  Qualitative components include:
  - Interviews
  - Focus groups of 4 groups including:
    - Technical experts
    - Ergonomic experts
    - Hand geometry users
    - Problematic users

- ✓ Quantitative components include:
  - Critical anthropometric elements
  - Surveys
  - Testing and statistical analysis



Review of current technology and literature

Qualitative and anthropometric analysis



Testing & Analysis

