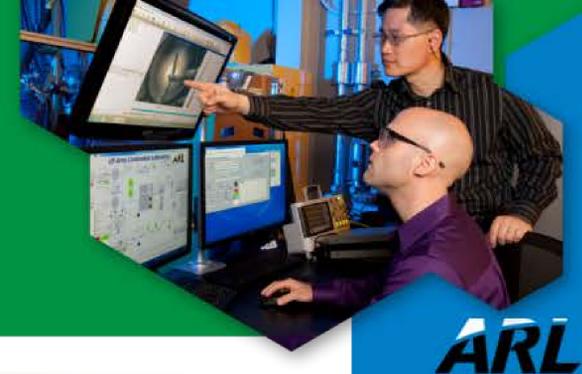
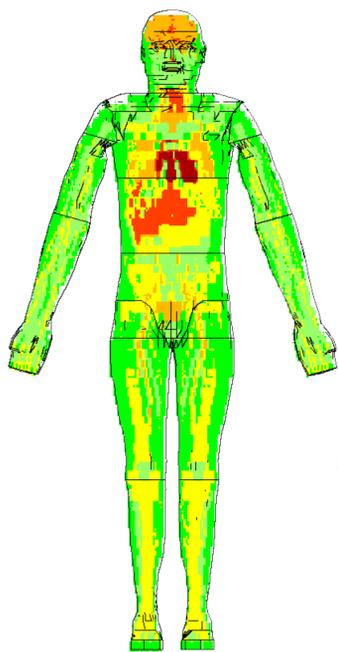


Vulnerability Modeling for Specific Human Morphologies

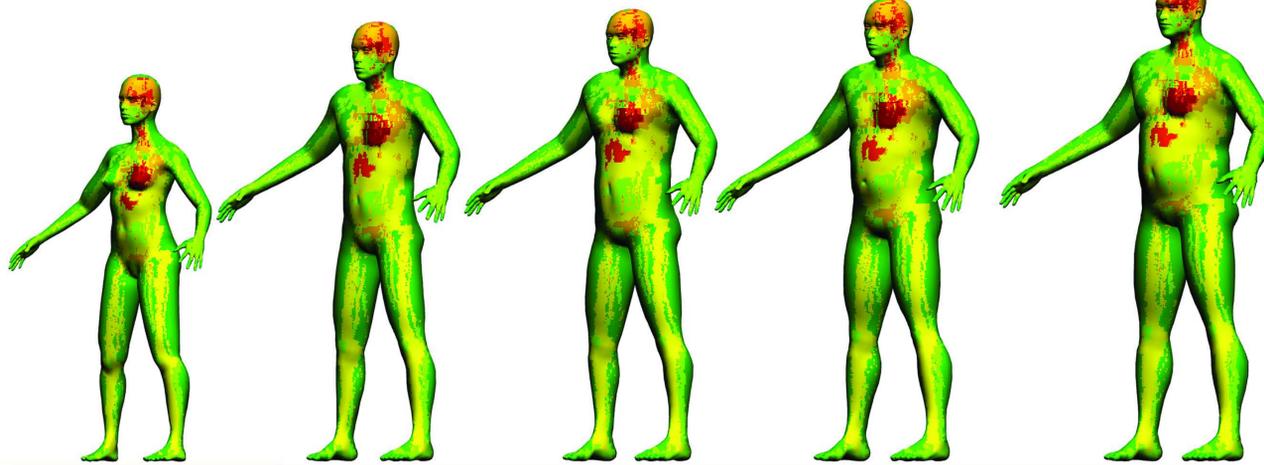


S&T Campaign: Assessment & Analysis
Military Injury Biomechanics

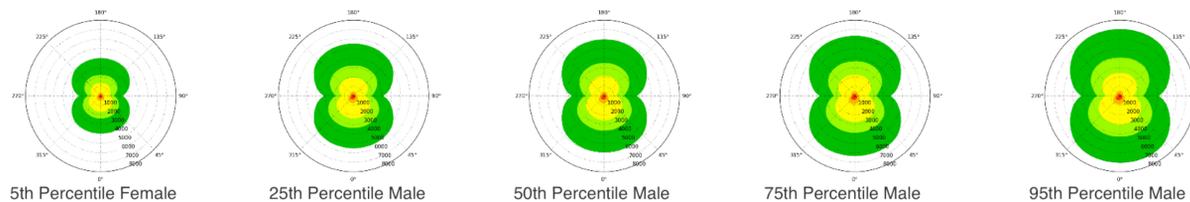
Timothy Myers, Autumn Kulaga & Patrick Gillich
(410) 278-2343
timothy.j.myers66.civ@mail.mil



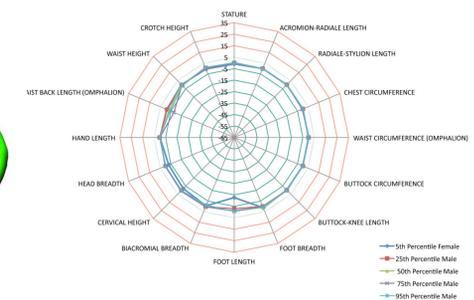
Operational Requirement-based Casualty Assessment (ORCA) model showing human vulnerability. ORCA outputs human vulnerability as Maximum Abbreviated Injury Score (MAIS) values.



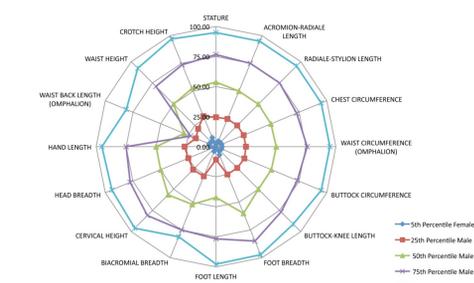
Anthropometrically-valid models display MAIS vulnerability at 0 degrees elevation and 315 degrees azimuth.



Cumulative MAIS values displayed by vulnerable area in cm² of each anthropometrically-based model at 0 degrees elevation for all azimuths. Here it is evident how the female presents a little more than half the vulnerable area of the 75th percentile male.



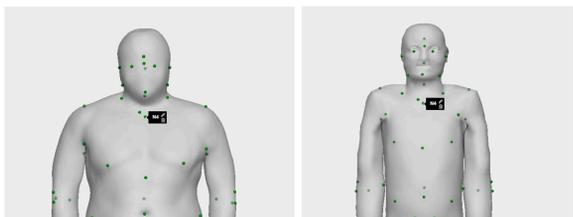
Anatomical measurements of the MakeHuman model as percentiles within the ANSUR II Pilot Study. This shows the actual percentile of the given measurement and how close it is to the desired Xth percentile measurement.



Percent difference of the anthropometrically-based models anatomical measurement compared to each ANSUR II Pilot Study.

Research Objective

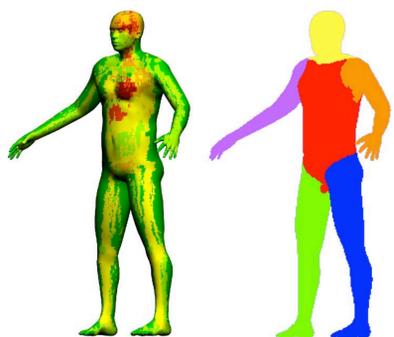
To improve the anthropometric representation in the human vulnerability model and in turn better represent the military population.



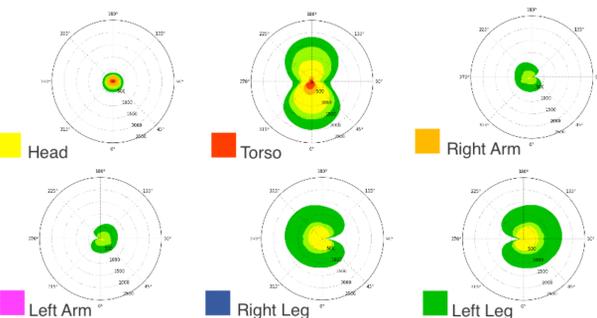
Model from Natick Scanned dataset (left) and the ORCA human vulnerability model (right) both showing anatomical landmarks to relate geometry.

Challenges

- Determining the best way to represent the entire military population and relate this to one human vulnerability model.
- Understanding how inner anatomy changes with respect to outer anatomy.



A color-coded body region map applied as a texture to the 50th percentile male model (right). Shown next to the 50th percentile male displaying MAIS vulnerability for 0 degrees elevation and 315 degrees azimuth.



From left to right, top to bottom: cumulative MAIS values for the head, torso, right arm, left arm, right leg, left leg body regions of 50th percentile male. These MAIS values display the vulnerable area in cm² of each anthropometrically based mannequin at elevation 0 and all azimuths. Here it is seen how the legs present twice as much vulnerable area than the arms, and the thorax presents the largest presented area of significant vulnerability.

ARL Capabilities Available to Support Collaborative Research

- ARL's human vulnerability model ORCA.
- Artistic 3-D modeling and sculpting capabilities.
- Capability to create 3-D geometry from medical data.
- Use and modification of the MakeHuman application to create a range of human geometry models.
- Framework for examining human vulnerability across morphologies.
- Geometry modeling expertise and vulnerability model repository.

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Computer vision expertise that can be used for model development.
- Anthropometric datasets and supporting analysis (e.g., CAESAR).
- Anatomical datasets from cadaver research that can be used for modeling anatomical features that can't be resolved well in radiology (e.g., nervous systems).
- Database of internal anatomical features that capture variability in a population.

References:

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Paquette, Steve, Claire Gordon, and Bruce Bradtmiller. Anthropometric Survey (ANSUR) II Pilot Study: Methods and Summary Statistics. Anthrotech Yellow Springs OH, 2009.
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