



SoldierSim™

PREDICTIVE HUMAN PERFORMANCE



PROCUREMENT
Evaluate solutions
before you buy

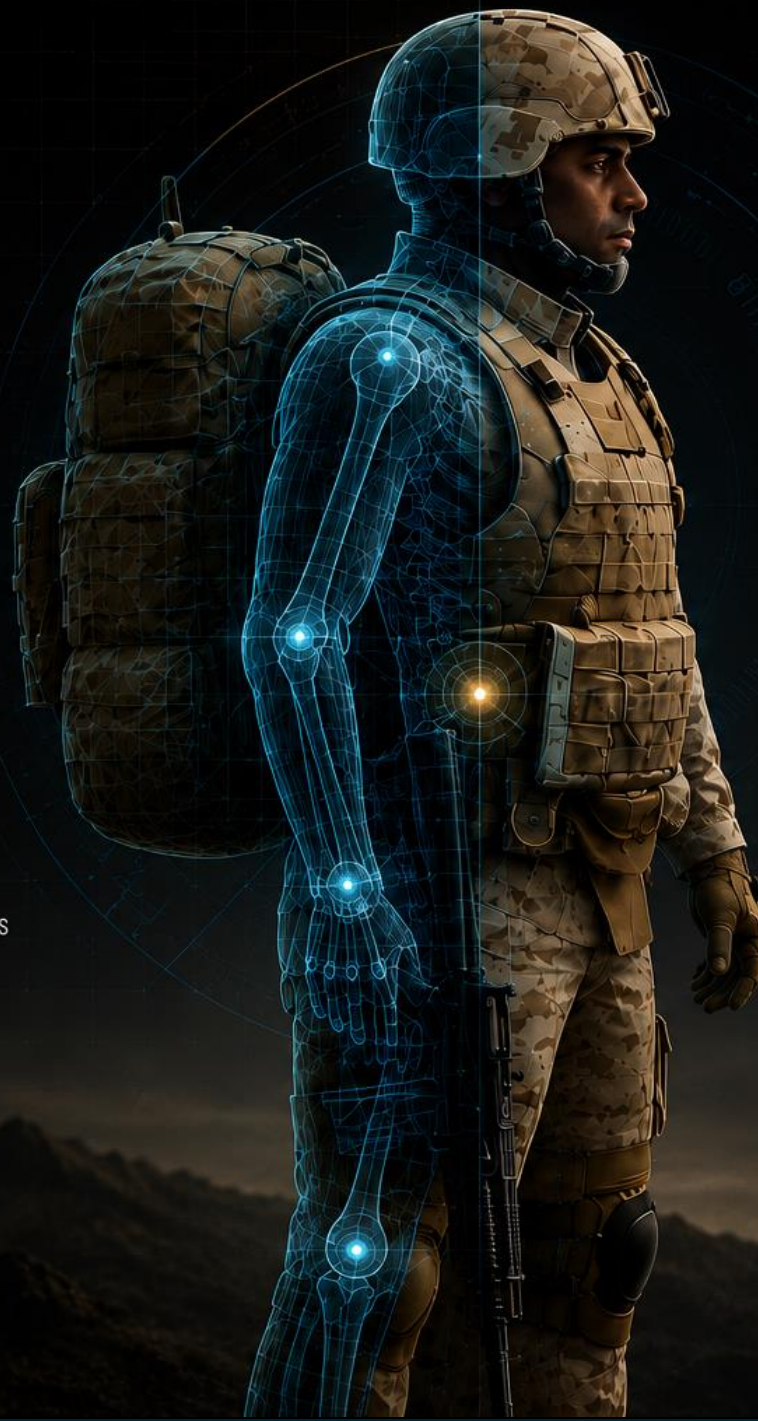


HUMAN PERFORMANCE
Predict fatigue, energy,
hydration, and more



EQUIPMENT DESIGN
Optimize gear and systems
for the human

PHYSICS-BASED. OPTIMIZATION DRIVEN. HUMAN CENTERED.



FATIGUE LEVEL
68%



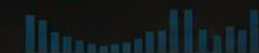
ENERGY EXPENDITURE
612 kcal/hr



HYDRATION STATUS
78%



JOINT LOADS
32 Nm



BALANCE & STABILITY





iHu



SoldierSim™
DIGITAL HUMAN ENGINEERING PLATFORM
FOR DEFENSE

SOLDIERSIM IS A DIGITAL ENGINEERING ENVIRONMENT, NOT JUST A SIMULATION APPLICATION.



1

**CONFIGURE
A SOLDIER.**

Anthropometry
Height, Weight,
Dimensions

Strength
Upper / Lower
Body

Flexibility
& ROM

Select from
16 different
configurations



Create a digital
representative.

2

**SELECT FROM
A LIBRARY OR
IMPORT EQUIPMENT.**

Use library assets
or import CAD.

3

**SELECT
A TASK.****EXAMPLE TASKS**

- Ladder Climb
- Stair Ascent
- Load Carriage
- Casualty Drag
- Ruck March



Choose or define
the task, conditions,
and constraints.

4

**PREDICT
PERFORMANCE.**

METABOLIC POWER
412 W
HEART RATE
156 bpm
FATIGUE INDEX
MODERATE
HYDRATION LOSS
1.2 L/hr
COMPLETION TIME
2.85 hr
DISTANCE
8.7 km



Physics + physiology
predict human
response.

5

**ANALYZE
ENGINEERING METRICS.**

Quantify results across
multiple dimensions.

6

**MAKE INFORMED
DECISIONS.****RECOMMENDED DECISION**

- Configuration B
- Optimal Load Distribution
- Within Biomechanical Limits
- Lower Fatigue
- Reduced Injury Risk
- Mission Success



Optimize designs,
missions, and
outcomes.



ACCELERATE
DESIGN



REDUCE COST
& PROTOTYPES



IMPROVE SAFETY
& READINESS



DATA-DRIVEN
DECISIONS

**BETTER ENGINEERING.
STRONGER SOLDIERS.**



SoldierSim™

DESIGN BETTER SYSTEMS.
PROTECT SOLDIERS.
MAKE BETTER DECISIONS.

WARRIOR CONFIGURATION

Dashboard

Eye Relief N/A
Aiming Reach Score N/A

Support Region Viewer

Ground Reaction Forces

Vertical
561 N L R 570 N
Forward 0 N Lateral 0 N

Spine Shear and Compression

Warrior Specs

2324 Female
Height: 213.38 lb

Warrior: 158.29
Gear: 45.26
Pack: 22.08
Clothing: 9.83

Bounding Box

Height: 0.94 m
Width: 1.71 m
Depth: 0.72 m

Cocoon Volume

Total: 0.38 m³
Avatar: 0.29 m³
Pack: 0.04 m³



EXTENDED LOAD CARRIAGE

Physiology

Aerobic Strain: Very Light

Energy Expenditure: 346.92 Watts
Metabolic Equivalent: 3.75 MET
Mechanical Power: 306.76 Watts
Steady State VO₂: 1.04 L/min
Estimated Heart Rate: 94.46 BPM

Activity Level: Moderate

Sustained hand and arm work such as hammering nails and filing.
Walking at a speed of 3.5 km/h to 5.5 km/h.

Suggested Hydration: 0.38 L/hr

Light

For an hour of this task, required water intake is about 0.38 bottles (16.9 fl oz).

Thermal

USARIEM Recommendations

Max Work: 300 min
Max Water: 0.2 qt/hr
Work Rest Cycle: 60 min
Work Rest Cycle Water: 0 qt/hr
Rest Water: 0.2 qt/hr
Heat Casualty: 0.08 %
Estimated Recovery: 2.3 min

Environmental Factors

Time of Day: Dusk
Temperature: 18.6 °C
Relative Humidity: 34 %
Wind Speed: 3.2 m/s
Mean Radiant Temp: 63.1 °C
Altitude: 500 m
ICLO Parameter: 0.72

SIMULATION BUILDER

Dashboard

Running Time: 00:00.87

Support Region Viewer

Ground Reaction Forces

Spine Shear and Compression

Anterior/Posterior Shear: -130 N
Medio-Lateral Shear: 0 N
Compression: 1134 N

Remaining Work Capacity

Scenarios

Custom, Stair Ascend, Stair Descend, Ladder Climb, Ladder Descend, Go Prone, Agility Run, Jump from Platform, Walk

EQUIPMENT EDITOR / GEAR IMPORT

Equipment Editor

Filename: USMC_Main_Pack.fox
Category: Pack
Name: USMC Main Pack
Icon: [Icon]

Model Properties

Weight: 22.08 kg
Scaling Units: Metric
Center of Gravity (m): X: 0.02, Y: 0.11, Z: 0.18
Inertia (kg*m²): XX: 0.24, XY: 0.01, XZ: 0.02, YY: 0.21, YZ: 0.00, ZZ: 0.19, YX: 0.00, YZ: 0.00, ZX: 0.02, ZY: 0.00, ZY: 0.00

Model Collision

Auto Fill Model with Spheres
Fill Model with 50 Spheres
Remove Spheres

Locator Properties

Position (m): X: 0.02, Y: 0.11, Z: 0.18
Rotation (deg): X: 0, Y: 0, Z: 0

Backpacks, Hydration Pack, Jammer Pack, USMC Assault Pack, USMC Main Pack, Armor Plates, Helmets, NVG Mounts, Pouches, Radio



PROCUREMENT
Evaluate solutions before you buy



HUMAN PERFORMANCE
Predict fatigue, energy, hydration, and more



EQUIPMENT DESIGN
Optimize gear and systems for the human



DATA DRIVEN
Quantify risk and improve outcomes



REDUCE RISK
Identify issues early and save costs



PROTECT SOLDIERS
Design for capability, safety, and success

What is SoldierSim?



SoldierSim enables engineers to configure digital soldiers, import equipment, simulate missions, predict human performance, and make better engineering decisions before physical testing.

1 CONFIGURE



Select anthropometry, configure posture and equipment, and evaluate instant engineering metrics.

2 IMPORT EQUIPMENT



Import CAD or 3D models, define weight, CG, inertia, attachments, and collision properties.

3 BUILD MISSION



Create scenarios using built-in tasks, terrain, conditions, and mission parameters.

4 PREDICT PERFORMANCE



Run simulations using Predictive Dynamics to compute physically feasible human motion.

5 ANALYZE RESULTS



Analyze fatigue, energy, hydration, joint loads, GRF, thermal, visibility, and more.

6 MAKE BETTER DECISIONS



Compare alternatives, optimize designs, reduce risk, and make confident engineering decisions before testing.



REDUCE RISK
Identify issues early



SAVE TIME & COST
Fewer prototypes and tests



IMPROVE PERFORMANCE
Optimize gear and missions



PROTECT SOLDIERS
Design for capability and safety



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SoldierSimTM

DIGITAL HUMAN ENGINEERING PLATFORM FOR DEFENSE

Configure A Soldier

Select from 16
Anthropometries



Anthropometry:
select from 16 anthropometries



Male / Female
Support for both male and female
soldiers



Height
From 5th to 95th percentile



Weight
Realistic weight for each percentile



Body Dimensions
Proportions and segment
dimensions



Strength
Strength percentile from
75% to 95%

Warrior Configuration - Untitled*

Open File Save File Reset Scene Change Units Show Alerts

Create Log Cmd Window View Help

Select Anthropometry

Filter: All Genders All Percentiles

Available Avatars (16)

	Santos ♂ 6 ft 1 in 173.72 lb 90% Strength
	220 Male ♂ 5 ft 7 in 160.94 lb 80% Strength
	508 Male ♂ 5 ft 7 in 143.52 lb 75% Strength
	530 Male ♂ 6 ft 3 in 244.93 lb 90% Strength
	601 Male ♂ 6 ft 2 in 155.43 lb 80% Strength
	1719 Male ♂ 5 ft 11 in 177.91 lb 85% Strength
	1953 Male ♂ 5 ft 7 in 195.11 lb 80% Strength
	2033 Male ♂ 6 ft 3 in 217.82 lb 90% Strength
	2459 Male ♂ 5 ft 4 in 122.14 lb 75% Strength

♂ 9 Male ♀ 7 Female

Male Avatars (9)

Santos 6 ft 1 in 173.72 lb 90%	220 Male 5 ft 7 in 160.94 lb 80%	508 Male 5 ft 7 in 143.52 lb 75%	530 Male 6 ft 3 in 244.93 lb 90%	601 Male 6 ft 2 in 155.43 lb 80%	1719 Male 5 ft 11 in 177.91 lb 85%	1953 Male 5 ft 7 in 195.11 lb 80%	2033 Male 6 ft 3 in 217.82 lb 90%	2459 Male 5 ft 4 in 122.14 lb 75%

Female Avatars (7)

Sophia 5 ft 6 in 133.00 lb 80%	0752 Female 5 ft 10 in 139.33 lb 80%	1806 Female 5 ft 9 in 164.91 lb 85%	2096 Female 5 ft 3 in 121.92 lb 75%	2316 Female 5 ft 7 in 156.75 lb 90%	2324 Female 5 ft 6 in 158.29 lb 90%	2531 Female 5 ft 0 in 129.19 lb 85%	2563 Female 5 ft 3 in 119.93 lb 75%



REALISTIC. DIVERSE. ENGINEERED FOR PERFORMANCE.

Choose the right soldier for your mission and the right data for your decisions.



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Equipment Configuration

Build the Soldier

Drag, drop, and configure equipment to create any loadout in seconds.



Helmet

Multiple helmet types and accessories



Weapon

Primary/secondary weapons and attachments



Armor

Vests, plates, and protective gear



Pack

Backpacks, rucks, hydration systems



Night Vision

NVGs and mounting options



Communications

Radios, headsets, antennas, upgrades

Warrior Configuration - Untitled*

Open File

Save File

Reset Scene

Change Units

Show Alerts

Create Log

Cmd Window

View Help

View

Avatars

Equipment

Postures

Flexibility

Output

Equipment Inventory
Total Load: 39.45 kg

▼ Helmet (2.35 kg)

✓ ACH Helmet

✓ NVG Mount

▼ Weapon (4.21 kg)

✓ M4A1 Carbine

✓ Optic (ACOG)

▼ Armor (11.62 kg)

✓ Plate Carrier (M)

✓ Side Plates

▼ Pack (18.40 kg)

✓ USMC Main Pack

✓ Hydration Bladder

✓ Radio Antenna

▼ Night Vision (0.68 kg)

✓ AN/PVS-14

▼ Communications (2.19 kg)

✓ PRC-152 Radio

✓ Headset

Add Equipment

Remove

1 Helmet
5 Night Vision
6 Communications
Radio & Headset
3 Armor
Plate Carrier & Plates
4 Pack
Backpack & Hydration
2 Weapon
M4A1 Carbine

Load Summary

Total Load **39.45 kg**

Total Weight (w/o soldier) 39.45 kg

Total Volume 0.056 m³

Center of Mass (m)

X: 0.02 Y: 0.11 Z: 0.18

Load Distribution

Back	56%
Torso	24%
Front	15%
Head	5%

Center of Mass

Height 1.82 m

From Ground 0.94 m

All

Helmet

Armor

Packs

Weapons

NVG

Comm

Accessories

ACH Helmet

MICH Helmet

FAST Helmet

M4A1 Carbine

M249 SAW

Plate Carrier (M)

Plate Carrier (M)

Plate Carrier (L)

USMC Main Pack

ILBE Pack

PRC-152 Radio

AN/PVS-14

Headset



BUILD FASTER

Create complete loadouts in minutes



ACCURATE LOADS

Realistic weight, balance, and volume



SEE INSTANTLY

Visualize fit, balance, and interference in real time



ENGINEER BETTER

Optimize designs before physical testing



SoldierSim™
DIGITAL HUMAN ENGINEERING PLATFORM

Configure A Soldier

- Anthropometry: select from 16 anthropometries
- Male/Female
- Height
- Weight
- Body dimensions
- Strength



Anthropometry



Male / Female



Height / Weight



Strength

Warrior Configuration - Untitled

Open File Save File Reset Scene Change Units Show Alerts Create Log Cmd Window View Help

Dashboard

Anthropometry

Gender: Male

Anthropometry: Santos ETOWL

Height: 1.82 m

Weight: 227.55 lb

Body Dimensions

Shoulder Width: 0.49 m

Hip Width: 0.36 m

Chest Depth: 0.33 m

Arm Length: 0.76 m

Torso Length: 0.67 m

Inseam: 0.85 m

Strength Percentile

Overall Strength: 90 %

Support Region Viewer

Ground Reaction Forces

Vertical: 473 N (L), 530 N (R)

Forward: 0 N (L), 0 N (R)

Lateral: 0 N (L), 0 N (R)

Center of Mass

Height: 0.94 m

From Ground: 0.94 m

Warrior Specs

Santos ETOWL

Height: 1.82 m

Weight: 227.55 lb

Warrior: 173.72

Gear: 44

Pack: 36.5

Clothing: 9.83

Bounding Box

Height: 0.81 m

Width: 1.85 m

Depth: 0.83 m

Cocoon Volume

Total: 0.50 m³

Avatar: 0.29 m³

Pack: 0.15 m³

Anthropometry Posture Eye Relief Aiming Envelope Support Region Reaction Forces Center of Mass Cocoon Bounding Box Avatar Visibility Collision Tracking



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Posture Configuration

Configure the soldier posture for any scenario.



Predefined Postures

Choose from a library of realistic, mission-relevant postures.



Mission Ready

Postures built from real-world data for accuracy and reliability.



Instant Application

Apply postures instantly and see the impact on performance, balance, and load.



Save and Reuse

Save custom configurations for repeatable analysis.

Posture Selection

Category: All

Selected Posture

Stand - Relaxed Standing

Natural upright stance at ease.

Apply Posture

Posture Details

Category: Standing

Description: Natural upright stance at ease.

Anthropometry

Name: 50th %ile Male

Height: 1.73 m

Weight: 77.1 kg

Gender: Male

Posture Metrics

Center of Mass Height: 0.94 m

Support Region Area: 0.38 m²

Balance Status: Stable



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Built-in Engineering Analysis

Comprehensive, physics-based analysis tools are built in to evaluate soldier performance, safety, and mission readiness.



Support Region

Evaluate stability and support polygon



Ground Reactions

Visualize forces and pressure distribution



Center of Mass

Track location and movement in real time



Joint Torque (N·m)

Analyze joint loads and identify critical joints



Bounding Box

Check clearances and spatial requirements



Cocoon Envelope

Understand total space claim for packaging and vehicle integration



Spine Loading

Understand spine shear and compression loading to reduce injury risk



Eye Relief

Verify eye-to-sight distance for land optics



Visibility

Assess line-of-sight and field of view



ENGINEER WITH CONFIDENCE. ANALYZE EVERYTHING THAT MATTERS.

Integrated analysis tools give you the insights needed to optimize equipment, reduce risk, and improve mission success.



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Import Your Equipment

Import CAD equipment into SoldierSim in minutes.

Equipment Editor - Assault_Backpack

New

Open

Save

Save As

Import CAD

Export

Add to Library

Properties

Check Interference

Units: m, kg

?

+

General

Geometry

Mass Properties

Attachment Locations

Textures

Interference

Reports



FRONT FRONT

Perspective

Front

Back

Left

Right

Top

Bottom

Equipment Properties

NameAssault_Backpack

CategoryBackpacks

DescriptionMedium assault backpack with modular pouches and hydration system.

Weight

Mass2.45 kg

Center of Gravity

X0.005 mY0.087 mZ0.215 m

Moments of Inertia (kg-m²)

lxx0.081

lxy-0.001

lxz0.000

lyx-0.001

lyy0.129

lyz-0.002

lzx0.000

lzy-0.002

lzz0.142

Attachment Locations

Name	Type
AP_Shoulder_Left	Rigid
AP_Shoulder_Right	Rigid
AP_Chest_Upper	Rigid
AP_Chest_Lower	Rigid
AP_Waist_Left	Rigid
AP_Waist_Right	Rigid
AP_Hip_Center	Rigid

Status: Ready

Triangles: 126,540

Vertices: 63,217



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DIGITAL HUMAN ENGINEERING PLATFORM FOR DEFENSE

Equipment Library

Access a comprehensive library of mission-ready equipment.



Helmet



Weapon



Backpack & Load Carriage



Armor & Protection



Electronics & Sensors



Communication



NVGs & Optics



Tools & Accessories



Medical & Survival



Vehicles & Components

Equipment Library



Import CAD



Add to Library



Properties



Preview on Soldier



Filters



Compare

Search equipment...



818



Categories

All	Equipment	1,452
	Helmet	194
	Weapon	356
	Backpack & Load Carriage	168
	Armor & Protection	218
	Electronics & Sensors	184
	Communication	142
	NVGs & Optics	134
	Tools & Accessories	96
	Medical & Survival	86
	Vehicles & Components	74

Filters

Manufacturer

All

Category

All

Compatibility

All

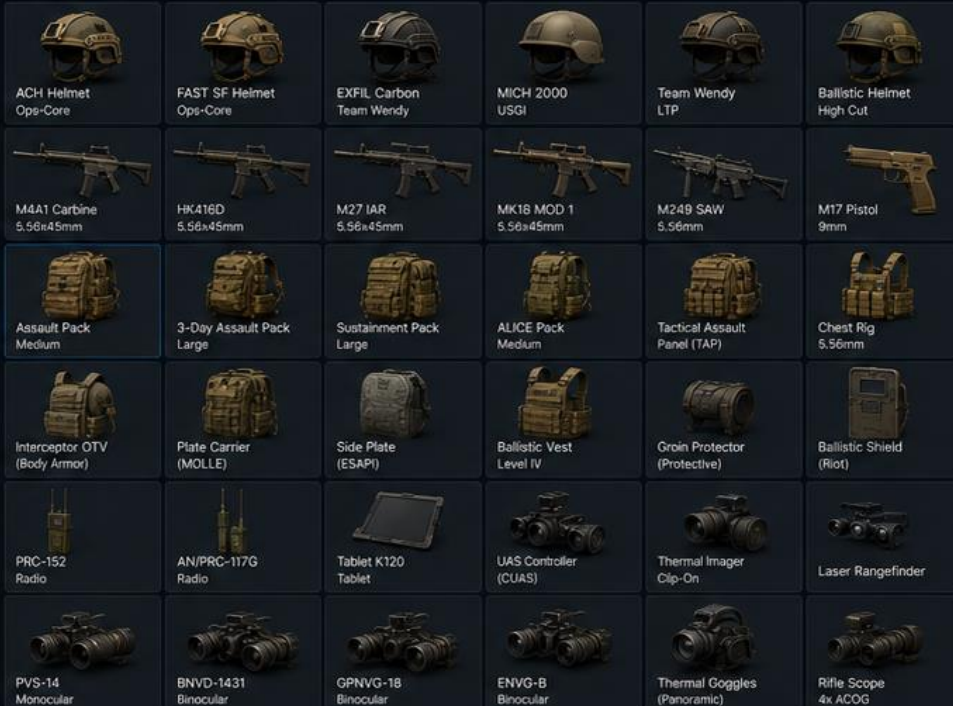
Weight (kg)

0

50+

Clear Filters

Showing 1,452 items



Assault Pack (Medium)



Equipment Properties

Weight 8.45 kg

Volume 45.2 L

Center of Gravity (m)

X 0.012 Y -0.045 Z 0.168

Moments of Inertia (kg-m²)

Ixx 0.237 Ixy -0.002 Ixz -0.001

Iyx -0.002 Iyy 0.412 Iyz -0.003

Izx -0.001 Izy -0.003 Izz 0.355

Compatibility

✓ All Soldier Configurations

✓ All Load Configurations

Attachment Points

AP_Shoulder_Left	Rigid
AP_Shoulder_Right	Rigid
AP_Chest_Upper	Rigid
AP_Waist_Left	Rigid
AP_Waist_Right	Rigid
AP_Hip_Center	Rigid
AP_Back_Upper	Rigid

WEAPONS



LOAD CARRIAGE



ELECTRONICS & NVGs



TOOLS & ACCESSORIES



IN USE



High-fidelity 3D models with accurate mass properties



Configurable and mission ready



Seamless integration with SoldierSim



Supports analysis of load, balance, and performance



Continuously expanding with new equipment



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DIGITAL HUMAN ENGINEERING PLATFORM FOR DEFENSE

Mission Scenarios

SoldierSim includes a library of built-in war fighting tasks that you can run and analyze in seconds.



Climb Ladder

Evaluate upper body effort, center of mass, and stability.



Ascend Stairs

Analyze energy cost, joint loads, and fatigue.



Go Prone

Assess time-to-prone and clearance.



Jump from Platform

Evaluate landing impact, joint loading, and risk.



Vertical Jump

Measure jump height, takeoff forces, and joint torques.

Scenario Library



New



Open



Save



Import



Run Scenario



Filters



View Details



Help

SCENARIOS

All Scenarios

Mobility

Upper Body

Load Carriage

Combat Tasks

Training & Fitness

Showing 5 of 25 scenarios

Climb Ladder



Climb a vertical ladder to a platform.



Duration
00:10



Difficulty
Medium



Category
Mobility

Ascend Stairs



Ascend a flight of stairs at a steady pace.



Duration
00:20



Difficulty
Medium



Category
Mobility

Go Prone



Transition from standing to prone position.



Duration
00:05



Difficulty
Easy



Category
Combat Tasks

Jump from Platform



Jump from a platform and land on the ground.



Duration
00:03



Difficulty
Medium



Category
Mobility

Vertical Jump



Perform a maximum vertical jump.



Duration
00:04



Difficulty
Hard



Category
Training & Fitness



Manage Scenarios





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SCENARIO: CLIMB LADDER



Task Playback and Analysis

Compare recorded and simulated performance with advanced biomechanical and physiological metrics.



Joint Torque Heat Maps

Identify high load areas and potential risk.



Ground Reaction Forces

Measure forces, balance and stability.



Energy Expenditure

Track metabolic cost and task duration.



Hydration & Physiology

Monitor hydration levels and physiological strain.



Performance Metrics

Compare key metrics side by side.

Task Comparison: Climb Ladder

REAL (RECORDED)

Time: 00:03.50 / 00:03.50



View



Configuration



Scenarios



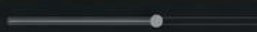
Analysis



Output



1x



00:03.50

SIMULATED (SOLDIERSIM)

Time: 00:03.50 / 00:03.50

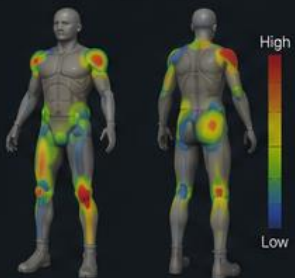


1x



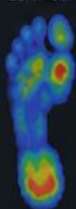
00:03.50

JOINT TORQUE HEAT MAP



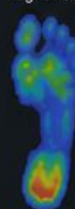
GROUND REACTION FORCES

Left Foot



Peak: 1.25 BW
Avg: 0.64 BW

Right Foot



Peak: 1.32 BW
Avg: 0.67 BW

ENERGY EXPENDITURE



Total Metabolic Work
1135.0 J

Eq. O₂ Consumption
0.952 L/min

HYDRATION & PHYSIOLOGY

Activity Level

Moderate

Suggested Hydration

Hydration Intake (16.9 oz bottles)

Heart Rate (Avg)

Core Temperature (Avg)

6.4 oz/hr

0.38 /hr

128 bpm

37.2 °C

Dashboard

Summary

Analysis

TASK SUMMARY

Task Duration	00:03.50
Total Metabolic Work	1135.0 J
Average Metabolic Power	324.3 W
Eq. O ₂ Consumption	0.952 L/min
Distance Traveled	2.35 m

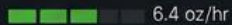
ACTIVITY LEVEL

Moderate



SUGGESTED HYDRATION

Light



6.4 oz/hr

KEY METRICS (COMPARISON)

Metric	Real	Simulated	Diff (%)
Max Torque	68%	67%	-1.5%
Peak Knee Torque (L)	2.2 Nm/kg	2.1 Nm/kg	-4.5%
Peak Ankle Torque (R)	1.9 Nm/kg	1.8 Nm/kg	-5.3%
Max Spine Compression	1420 N	1406 N	-1.0%
Max Spine Shear	225 N	218 N	-3.1%
Step Count	6	6	0%
Average Speed	0.68 m/s	0.67 m/s	-1.5%



Joint Torque Map



Spine Shear
Compression



Reaction Forces



Center of Mass



Collision Tracking

Units: SI (m, kg, N, s)

Frame: 210 / 210

Cause and Effect

Change the load configuration and visualize the impact on human performance, fatigue, and injury risk in seconds.

LOAD CONFIGURATION

BASILINE LOAD

- Backpack: 25 kg
- Body Armor: 8 kg
- Helmet: 1.4 kg
- Weapon: 3.6 kg
- Total Load: 38.0 kg

CHANGED LOAD

- Backpack: 38 kg (+13 kg)
- Body Armor: 10 kg (+2 kg)
- Helmet: 1.4 kg
- Weapon: 3.6 kg
- Total Load: 53.0 kg (+15 kg)

KEY TAKEAWAY

- ! The increased load leads to higher joint torques, greater metabolic cost, and elevated injury risk—especially at the knees, lower back, and ankles.

SCENARIO: CLIMB LADDER

BASILINE LOAD (38.0 kg)

Total Time
00:02.78

Max Height
2.88 m

Total Metabolic Work
1674.7 J

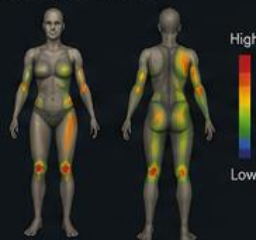
Avg. Metabolic Power
610.6 W

Eq. O₂ Consumption
1.792 L/min



00.02.78

JOINT TORQUE HEAT MAP



GROUND REACTION FORCES



ENERGY EXPENDITURE



HYDRATION & PHYSIOLOGY

Activity Level
Moderate

Suggested Hydration
16.0 oz/hr

Heart Rate (Avg)
118 bpm

Core Temperature (Avg)
37.1 °C

CHANGED LOAD (53.0 kg)

Total Time
00:03.35 (+20%)

Max Height
2.88 m

Total Metabolic Work
2321.8 J (+39%)

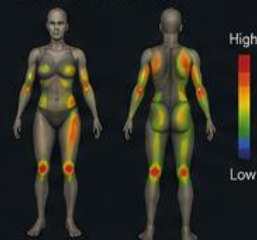
Avg. Metabolic Power
794.3 W (+30%)

Eq. O₂ Consumption
2.334 L/min (+30%)



00.03.35

JOINT TORQUE HEAT MAP



GROUND REACTION FORCES



ENERGY EXPENDITURE



HYDRATION & PHYSIOLOGY

Activity Level
High

Suggested Hydration
22.0 oz/hr

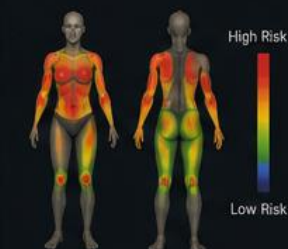
Heart Rate (Avg)
136 bpm (+15%)

Core Temperature (Avg)
37.6 °C (+0.5 °C)

PERFORMANCE IMPACT

- Total Metabolic Work
+39%
- Average Metabolic Power
+30%
- Eq. O₂ Consumption
+30%
- Task Duration
+20%
- Max Knee Torque (L)
+35%
- Max Spine Compression
+18%

INJURY RISK CHANGE



Highest Risk Increases:

- Knees (L/R)
- Lower Back (Spine)
- Ankles



Cause and Effect

See how increasing backpack load impacts the human.



Increase Backpack



Center of Mass Shifts



Joint Loads Increase



Energy Increases



Performance Decreases

SCENARIO: Climb Ladder

BASILINE LOAD (25 kg backpack)

Total Time
00:02.78

Max Height
2.88 m

Total Metabolic Work
1674.7 J

Avg. Metabolic Power
610.6 W

Eq. O₂ Consumption
1.792 L/min



CENTER OF MASS (Side View)



JOINT TORQUE HEAT MAP



ENERGY EXPENDITURE



Total Metabolic Work
1674.7 J

Eq. O₂ Consumption
1.792 L/min

HYDRATION & PHYSIOLOGY

Activity Level
Moderate

Suggested Hydration
16.0 oz/hr

Heart Rate (Avg)
118 bpm

Core Temperature (Avg)
37.1 °C

INCREASED LOAD (55 kg backpack)

Total Time
00:03.45 (+24%)

Max Height
2.88 m

Total Metabolic Work
2321.8 J (+39%)

Avg. Metabolic Power
794.3 W (+30%)

Eq. O₂ Consumption
2.334 L/min (+30%)



CENTER OF MASS (Side View)



JOINT TORQUE HEAT MAP



ENERGY EXPENDITURE



Total Metabolic Work
2321.8 J (+39%)

Eq. O₂ Consumption
2.334 L/min (+30%)

HYDRATION & PHYSIOLOGY

Activity Level
High

Suggested Hydration
22.0 oz/hr (+38%)

Heart Rate (Avg)
136 bpm (+15%)

Core Temperature (Avg)
37.6 °C (+0.5 °C)

PERFORMANCE IMPACT

- Total Metabolic Work
+39%
- Average Metabolic Power
+30%
- Eq. O₂ Consumption
+30%
- Task Duration
+24%
- Max Knee Torque (L)
+35%
- Max Spine Compression
+18%

PERFORMANCE DECREASE

- Stability Margin
-18%
- Movement Efficiency
-16%
- Fatigue Increase
High



iHuman

SoldierSim™

DIGITAL HUMAN ENGINEERING PLATFORM FOR DEFENSE

Automatic Reports

Generate comprehensive performance reports automatically with engineering metrics, charts, and actionable recommendations.



Engineering Metrics

Key biomechanical, physiological, and performance metrics computed automatically.



Charts & Visualizations

Clear graphs and heat maps help you quickly understand performance impacts.



Recommendations

AI-driven insights and engineering recommendations to reduce risk and improve performance.



Export & Share

Export to PDF, Excel, or CSV and share with your team in one click.

SOLDIERSIM AUTOMATIC REPORT



Scenario:
Climb Ladder

Subject:
Female (SOPHIA)

Date:
May 20, 2025 10:15 AM

Load Configuration

Backpack: 55.0 kg
Body Armor: 10.0 kg
Helmet: 1.4 kg
Weapon: 3.6 kg
Total Load: 70.0 kg

EXECUTIVE SUMMARY

Total Time: 00:03.45 (+24%)
Total Metabolic Work: 2321.8 J (+39%)
Avg. Metabolic Power: 794.3 W (+30%)
Peak Knee Torque (L): 2.2 Nm/kg (+35%)
Max Spine Compression: 1420 N (+18%)

ENERGY EXPENDITURE



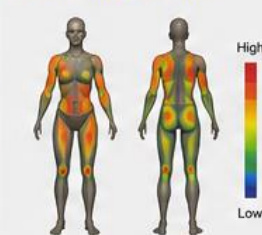
Total Metabolic Work: 2321.8 J (+39%)
Eq. O₂ Consumption: 2.334 L/min (+30%)

GROUND REACTION FORCES



Left Foot: Peak: 1.35 BW, Avg: 0.77 BW
Right Foot: Peak: 1.32 BW, Avg: 0.82 BW

JOINT TORQUE HEAT MAP



HYDRATION & PHYSIOLOGY

Activity Level: High
Suggested Hydration: 22.0 oz/hr (+38%)
Heart Rate (Avg): 136 bpm (+15%)
Core Temperature (Avg): 37.6 °C (+0.5 °C)

PERFORMANCE METRICS

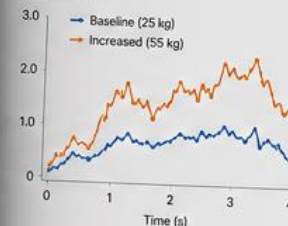
Stability Margin: -18%
Movement Efficiency: -16%
Fatigue Increase: High
Task Duration: 00:03.45 (+24%)
Max Height Reached: 2.88 m

RECOMMENDATIONS

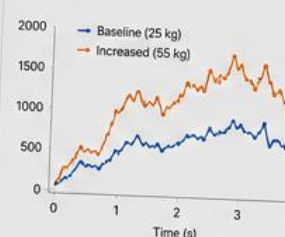
- Reduce backpack load if possible to lower joint loads and metabolic cost.
- Strengthen lower body (quadriceps, glutes) to improve climbing performance.
- Increase hydration intake during operations.
- Consider load redistribution to reduce spinal compression.

DETAILED CHARTS

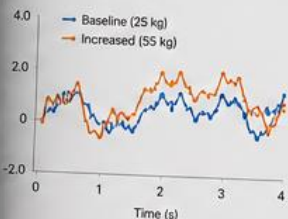
KNEE TORQUE (LEFT) (Nm/kg)



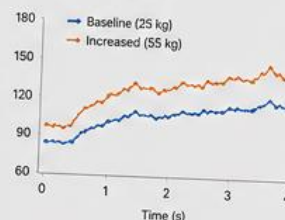
SPINE COMPRESSION (N)



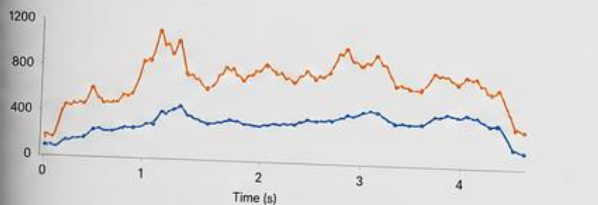
HIP POWER (W/kg)



HEART RATE (bpm)



METABOLIC POWER (W)



EXPORT REPORT



PDF
Document



Excel
Workbook



CSV
Data File



Share
Report Link

APPLICATIONS

SoldierSim enables data-driven decisions across the soldier equipment lifecycle—from concept to fielded capability.



1. PROCUREMENT

Make better acquisition decisions with confidence.

TRADE STUDY COMPARISON

	Configuration A	Configuration B	Configuration C
Total Metabolic Cost (J)	2150	1890	2410
Avg. Metabolic Power (W)	310	270	345
Task Completion Time (s)	320	295	348
Peak Knee Torque (Nm)	210	185	240
Spine Compression (N)	1420	1180	1620
Injury Risk Index	0.42	0.28	0.55

COST vs PERFORMANCE



- Compare equipment and load configurations
- Quantify performance, risk, and cost trade-offs
- Support requirements, source selection, and budgeting
- Reduce program risk and total ownership cost



OUTCOME: Smarter investments.
Higher readiness. Lower risk.



2. EQUIPMENT DESIGN

Design better equipment that fits, protects, and performs.



Spine Compression (N)

1180 ↓ -18%

Shoulder Load (N)

420 ↓ -15%

Pressure Peak (kPa)

48.2 ↓ -22%

- Import CAD and evaluate fit, clearances, and ergonomics
- Assess biomechanics, comfort, and injury risk
- Optimize design before physical prototyping
- Accelerate innovation and reduce development cost



OUTCOME: Better designs.
Fewer prototypes. Faster to field.



3. HUMAN PERFORMANCE

Optimize soldier performance and mission effectiveness.



METABOLIC POWER (W)



HEART RATE (bpm)



HYDRATION LOSS (L)



FATIGUE INDEX



TASK COMPLETION TIME (s)

295 s

ADVISED LOAD REDUCTION

-7.5 kg

- Predict fatigue, metabolic cost, and injury risk
- Evaluate loads, tasks, and environmental conditions
- Support training, load planning, and mission design
- Improve readiness and extend operational effectiveness



OUTCOME: Stronger soldiers.
Better performance. Mission success.



SCIENTIFIC FOUNDATION

Only Now Possible.

23 years of development for the US Military: the reason is **Predictive Dynamics**

MOTION CAPTURE



REPLAY



Shows what happened.

VS.

PREDICTIVE DYNAMICS



Newton-Euler Dynamics

$$M(q)\ddot{q} + C(q, \dot{q})\dot{q} + G(q) = \tau + J^T F$$

Optimization

$$\min_{q, \tau} -J(q, \dot{q}, \tau)$$

subject to

Dynamics + Constraints

Limits + Objectives



Dynamics



Strength



Limits



Objectives

PREDICTION



Predicts what will happen.

Enables what-if analysis, optimization, and decision-making.



23 YEARS OF DEVELOPMENT FOR THE US MILITARY
 The breakthrough is **Predictive Dynamics**.



Physics-Based
Human Modeling



Optimization
& AI



Scientifically
Validated



Built for
Warrior Performance

PHYSICS AND PHYSIOLOGY

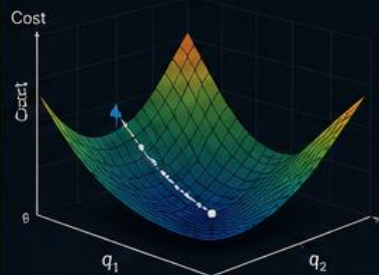
SoldierSim integrates the science of the human and the real world to predict motion and performance.

PHYSICS



- Newtonian mechanics
- Rigid body dynamics
- Joint kinematics & constraints
- Ground contact & friction
- External forces

OPTIMIZATION



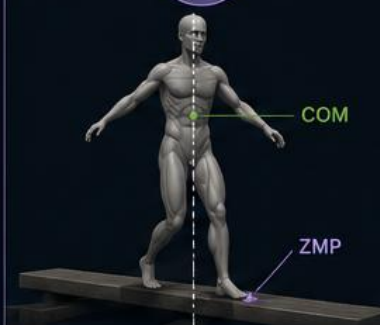
- Objective minimization
- Multi-objective trade-offs
- Constraints (joints, limits, contact)
- Efficient, scalable solvers
- Best solution for the task

HUMAN STRENGTH



- Muscle strength models
- Joint torque capabilities
- Strength variations (sex, size, age, training)
- Fatigue & endurance limits
- Injury risk prevention

BALANCE



- Center of mass (COM)
- Zero moment point (ZMP)
- Stability & postural control
- Dynamic balance
- Fall prevention

ENVIRONMENT



- Terrain & slope
- Surface properties
- Temperature & altitude
- Wind & weather
- Operational conditions

MOTION



Science-Based
Predictive Modeling



Validated with
Military Data



Accurate Predictions
of Human Performance



Better Decisions
Faster, Safer, Smarter



iHuman

SoldierSim™

DIGITAL HUMAN ENGINEERING PLATFORM FOR DEFENSE

Scientifically validated.
Trusted by the U.S. Military.

VALIDATION

Extensive validation ensures SoldierSim delivers accurate, reliable, and decision-ready results.

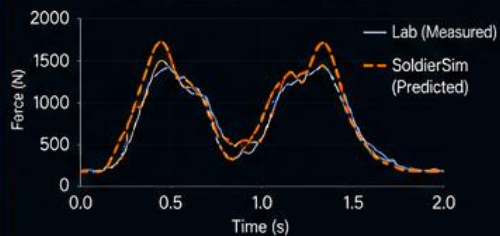


LABORATORY

Controlled experiments
in biomechanics labs



Ground Reaction Force – Vertical



- Instrumented force plates, EMG, and 3D kinematics
- Predicted GRF, joint moments, and muscle activity
- High correlation with experimental data

R^2 typically > 0.85



MILITARY

Validated with U.S. Army
tests and evaluations



Metabolic Power (W)



- ACFT, load carriage, and mobility assessments
- Predicts energy expenditure and performance
- Supports program decisions and requirements



PUBLISHED RESEARCH

Peer-reviewed studies confirm
accuracy and predictive capability



and
more...

Prediction Accuracy Across Studies (R^2)



- Validated in leading biomechanics journals
- Covers wide range of tasks and conditions
- Consistent accuracy across populations

Strong scientific foundation

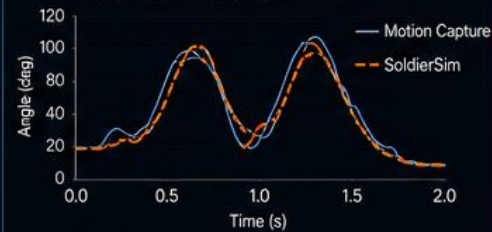


MOTION CAPTURE

Validated against high-fidelity
motion capture data



Joint Angle – Right Knee Flexion



- 3D motion capture for kinematics
- Joint angles and trajectories comparison
- High fidelity across tasks and speeds

Provides confidence in every prediction



Multiple methods. Thousands of data points.
One accurate digital human.

Validated. Verified. Trusted.



Data from hundreds
of Soldiers and Marines



10+
Laboratory
studies



180+
Peer-reviewed
publications



100+
Motion capture
datasets

WHY SOLDIERSIM?

Data-driven insights. Scientific accuracy. Real-world impact.



REDUCE PROTOTYPES

Virtually test and refine designs before building physical prototypes.

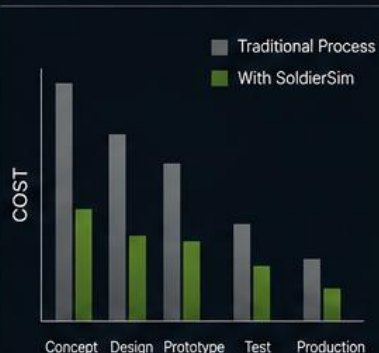


50–80%
Fewer physical prototypes



REDUCE COST

Minimize physical testing, field trials, and late-stage design changes.



30–60%
Lower program costs



IMPROVE SAFETY

Identify risks early, reduce injury potential, and design safer equipment and missions.

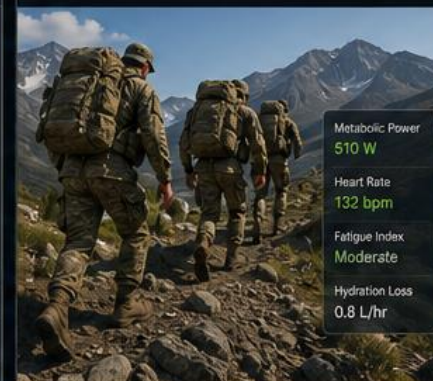


Fewer Injuries
Lower risk to the warfighter



IMPROVE READINESS

Optimize loads, tasks, and equipment to enhance performance, endurance, and mission success.



Higher Performance
Better endurance. Mission ready.



ACCELERATE PROCUREMENT

Make informed, data-driven decisions faster with confidence and traceable evidence.



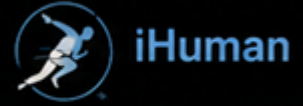
30–70%
Faster decision cycles



SOLDIERSIM TRANSFORMS HOW WE ENGINEER FOR THE WARFIGHTER.
 Better decisions. Lower risk. Stronger soldiers.



WHY IT IS DIFFERENT

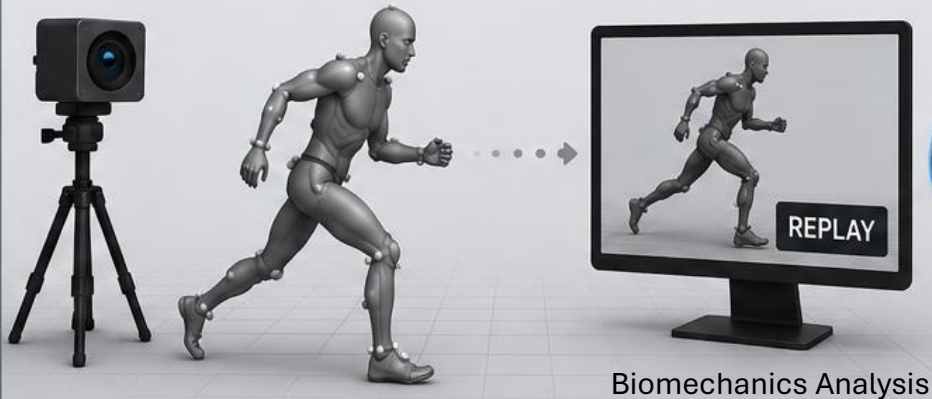


Most software visualizes.

SoldierSim predicts.

MOST SOFTWARE VISUALIZES

Shows what happened.



VS.

SOLDIERSIM PREDICTS

Predicts what will happen.



Descriptive | Past | What happened
Limited to replay and visualization.



Predictive | Future | **What will happen**
Computes optimal, physics-based human response.



IT IS COMPLETELY PHYSICS BASED!

Newtonian mechanics • Human physiology • Optimization • Constraints

LEADERS TRUST SOLDIERSIM

ETOWL IS ALSO GRUNTSIM. ETOWL IS ALSO SOLDIERSIM.

“ETOWL (GruntSim) fits perfectly within ONR’s mission to develop groundbreaking technologies that enhance the resilience, physical superiority and overall warfighting performance of U.S. Marines.”



Brig. Gen. Kevin Killea
Vice Chief of Naval Research



BUILDING A BETTER GRUNT: ONR-SPONSORED TECHNOLOGY TO LIGHTEN MARINES' LOADS
For Immediate Release: Jun 08, 2015

“The benefits of ETOWL are numerous, said. For example, the Marine Corps can use data from the virtual tests to quickly design real-world prototypes for testing by live Marines.”

It’s very exciting to see ETOWL transition from ONR prototype to a technology that will enhance human load and performance for the Marine Corps, this is the kind of research that’s very rewarding because it provides a direct benefit to our nation’s warfighters.”



Dr. Peter Squire
ONR Program Manager
Expeditionary Maneuver Warfare and
Combating Terrorism Department



<https://www.onr.navy.mil/media-center/news-releases/building-better-grunt-onr-sponsored-technology-lighten-marines-loads>



THE UNIVERSITY OF IOWA



GruntSim™

DIGITAL HUMAN ENGINEERING
PLATFORM FOR GROUND FORCES



SoldierSim™

DIGITAL HUMAN ENGINEERING
PLATFORM FOR ALL WARFIGHTERS



ETOWL™

ENGINEERING TOOLS FOR
OPTIMIZED WARFIGHTER LOADS

ADVANCING TECHNOLOGY.
ENHANCING PERFORMANCE.
STRENGTHENING OUR WARFIGHTERS.



iHuman

SoldierSim™

DIGITAL HUMAN ENGINEERING PLATFORM
FOR DEFENSE



DESIGN BETTER EQUIPMENT

PROTECT SOLDIERS

MAKE BETTER DECISIONS



ENGINEERING
EXCELLENCE



SOLDIER
PROTECTION

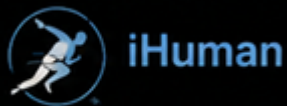


DATA-DRIVEN
DECISIONS



FASTER
ACQUISITION

SCIENCE. SIMULATION. SUPERIOR PERFORMANCE.



SoldierSim™
DIGITAL HUMAN ENGINEERING PLATFORM
FOR DEFENSE

ABOUT US

After **23 years** of R&D at the University of Iowa and funded by the US Military, private and public companies, the Santos technology has matured and is ready to help with projects.

The multidisciplinary team with expertise in Engineering, Military, Athletics, Medicine, AI, Computer Science has transitioned from the University of Iowa to **iHuman Technology**.



OUR MULTIDISCIPLINARY TEAM



ENGINEERING

Biomechanics,
mechanical &
systems
engineering



MILITARY

Operational
experience,
warfighter
focus



ATHLETICS

Performance
optimization,
sports
science



MEDICINE

Human
physiology,
injury
prevention



AI

Machine
learning, data
analytics,
prediction



COMPUTER SCIENCE

Software
development,
simulation,
visualization



SCIENCE. SIMULATION. SUPERIOR PERFORMANCE.

Better equipment. Protect soldiers. Make better decisions.

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23 YEARS
OF R&D



U.S. MILITARY
FUNDED



TRUSTED BY
INDUSTRY &
GOVERNMENT