



Individual Protection System Performance Model (IP SPM) Gen-2

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Objectives:

Develop the Individual Protection System Performance Model (IP SPM) second-generation (Gen-2) with physics-based modeling and simulation (M&S) capabilities for:

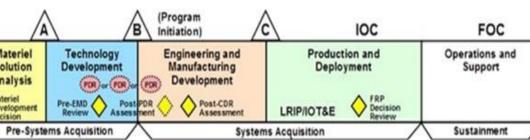
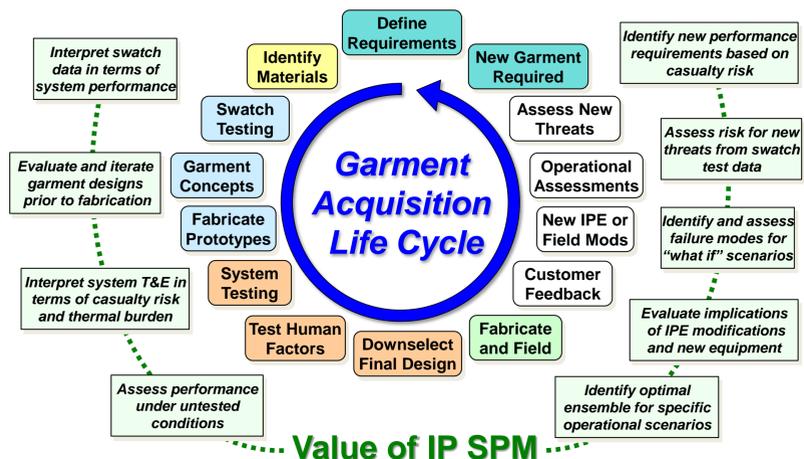
- Characterizing the protective and thermal performance of IP garment ensembles
- Enhancing analysis, interpretation and understanding of swatch, component and system test data
- Assessing toxicological casualty risk and thermal burden for existing and future IP garments and materials
- Ultimately providing better protection for the Warfighter

Description of Effort:

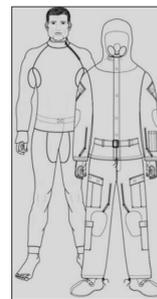
- Building upon capabilities of the Gen-1 IP SPM
- Model combines a physics-based, mechanistic characterization of the transport phenomena relevant to IP materials with a simplified representation of the Warfighter and IP garment ensemble.
- Software framework of the IP SPM consists of three components: (1) simulation builder, (2) modeling engine, and (3) simulation results viewer
- Model endpoints include toxicological casualty risk and thermal burden assessments for specified operational conditions
- Validating physics-based models by comparison to component and system-level test data, including man in simulant test (MIST), aerosol system test (AST), and thermal manikin studies
- Supporting the U.S. Army Natick Soldier Research, Development and Engineering Center's (NSRDEC) Integrated Protective Fabric System (IPFS) program through IP SPM analysis of testing and evaluation (T&E) data and comparisons of garment design alternatives (see related poster at this conference)

Benefits:

Garment Acquisition Life Cycle



Garment Design



New Designs or Fielded Garments

IP SPM Model



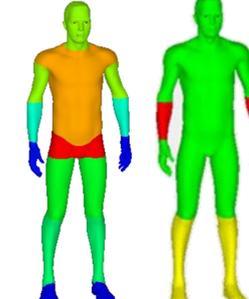
Garment, Environmental and Challenge/Threat Conditions

Predicted Under-garment CT, Temperature and RH



Garment, Environmental and Challenge/Threat Conditions

Casualty Risk and Heat Stress

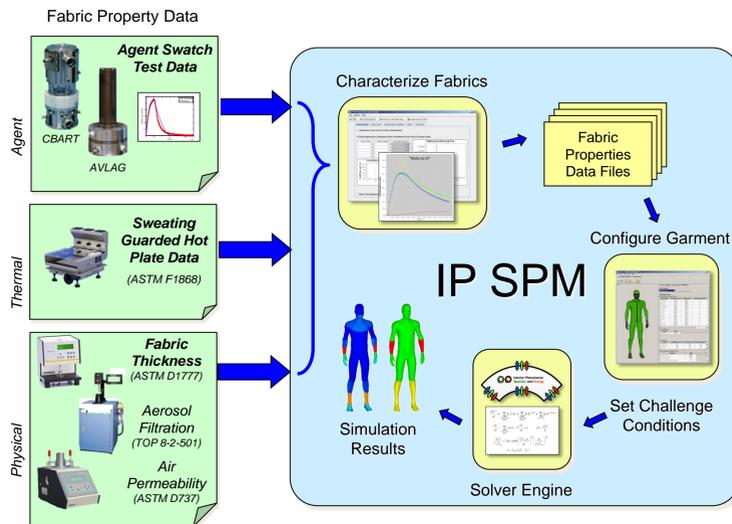


Under-garment Temp/RH Conditions, Blistering and Nerve Agent Toxicity

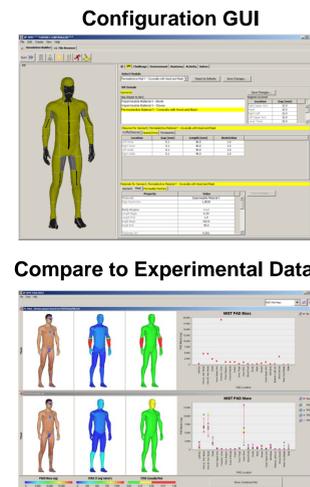
Features

- Flexible user interface allows specification of seams, vents, multiple fabric layers, fabric patches, pads, ballistic vest, hood/mask interface.
- Configurable challenge types include liquid droplets, agent vapor, monodisperse aerosols.
- Toxicological casualty risk assessment (TCRA) estimates casualty risk using an updated BRHA methodology.
- Thermal simulations output suit temperature and relative humidity (RH) for subsequent analysis with thermal effects software tools (e.g. HSDA)

Software Design



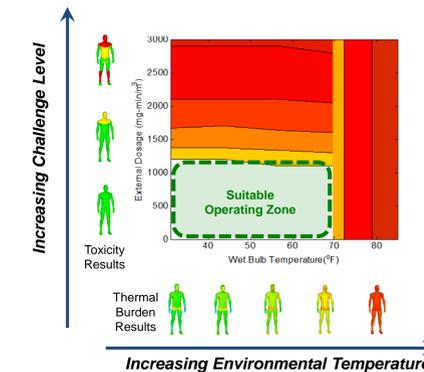
Software Interface



Compare to Experimental Data

Includes Comparisons to Toxicological Casualty Risk Estimates

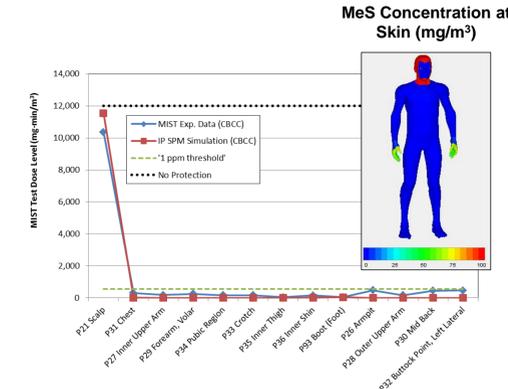
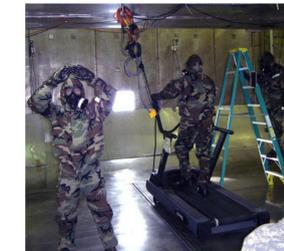
Example: Tradespace Analyses



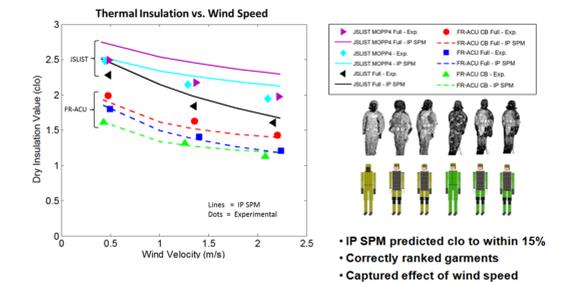
- Conduct multiple simulations at varying environmental and challenge conditions.
- Define performance metrics (e.g. suit temperature, concentration time (CT) dosage, mission time limit, etc.).
- Set performance thresholds to determine suitable operational envelopes.

Initial Validation Results

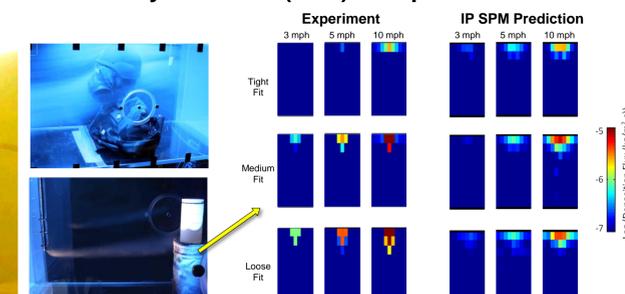
Man in Simulant Test (MIST) Comparison



Thermal Manikin Comparison



Aerosol System Test (AST) Comparison



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