MALUM (injury prediction)

A human injury prediction and human performance analysis tool based on AI and sensory input. By monitoring soldiers' training, stress and sleep levels, injuries, and sensory data such as accelerometers, MALUM uses SANTOS and Deep Learning to predict and mitigate injury

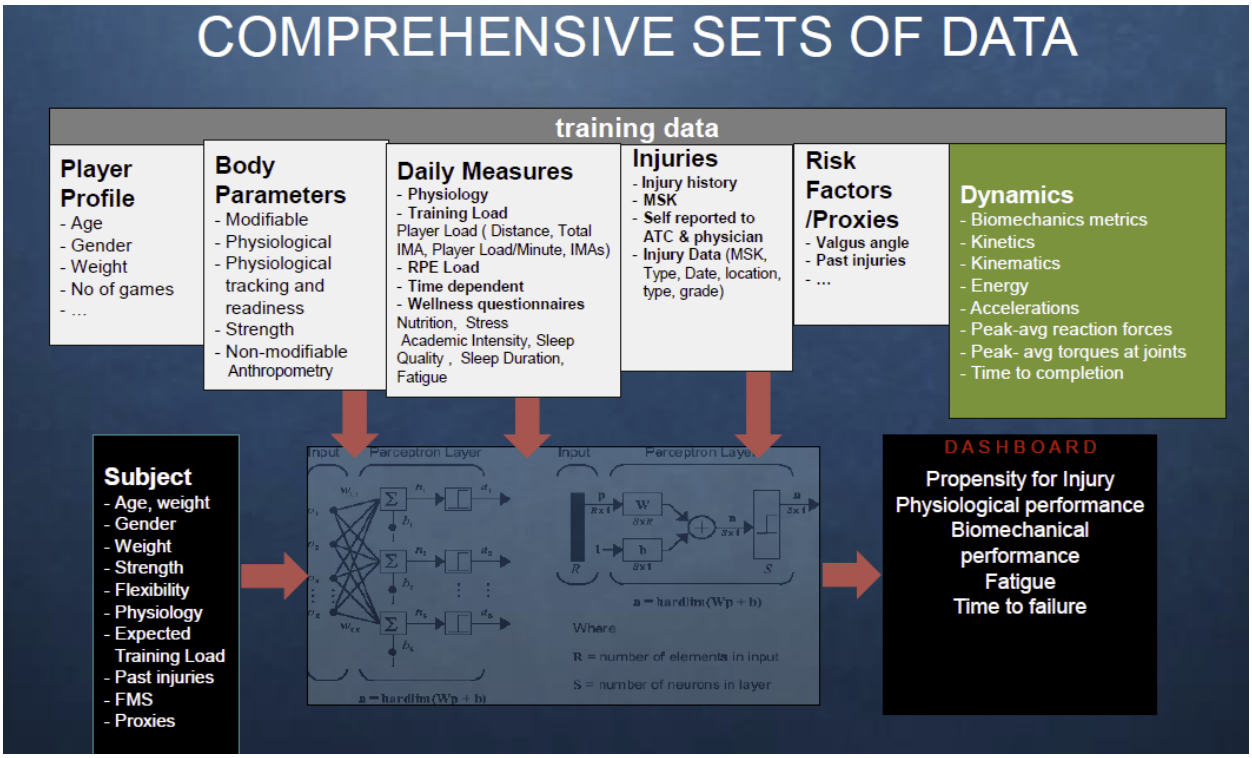
MALUM

A simulation system for injury prediction and human performance

Virtual Soldier Research – University of Iowa

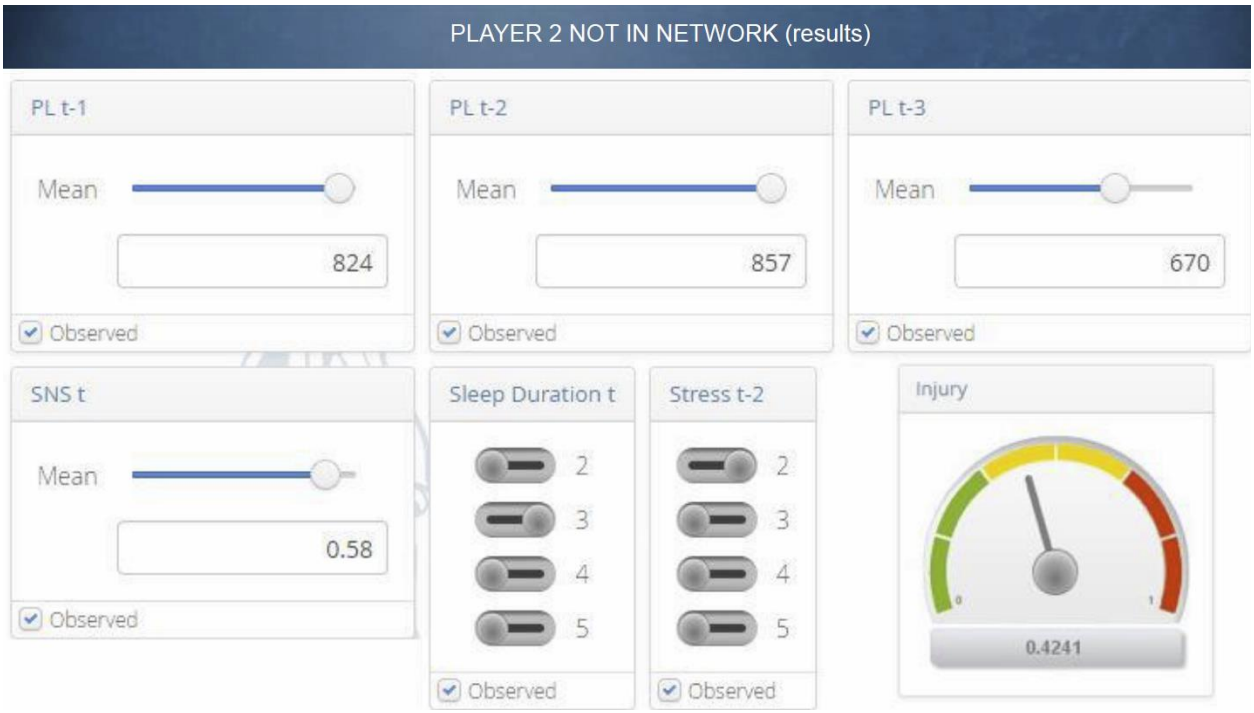
Musculoskeletal injuries (MSK-I) of Warfighters are substantial, cause millions of lost-duty days, and are arguably the leading medical problem eroding military readiness. Most of these injuries are non-battle injuries.

The output of the system is a determination of the propensity of injury for a specific MSK injury and for a particular task that have been specified. An additional output is a dashboard that shows a real-time simulation. A significant capability of the MALUM TERMINUS simulation system is its ability to import experimental data and existing models. This effort will enable capabilities to import related data, process these data through computational models to yield mathematical representations, and implement these representations in functioning modules that interact with other modules within the overall simulation system



HOW DOES IT WORK?

Building upon the SANTOS® human simulation environment, MALUM will create a virtual avatar of an individual Warfighter by taking in various physical, physiological, and biomechanical parameters. A user will then be able to prescribe high intensity tasks to the virtual Warfighter. The software will then simulate the Warfighter and use data available from other commercially available human monitoring systems to predict jury risk to the Warfighter in performing these tasks.



Major Capabilities

- Predicting human MSK injuries
- Human motion prediction models are now mature
- Integrating simulation models for large data
- AI Deep Learning models incorporated to classify motion and predict injuries
- Predictive models that can deal with missing data
- Injury prediction models are limited to MSK injuries of the lower limbs
- Accessibility to tracked data: Athletics + Military

Major Result:

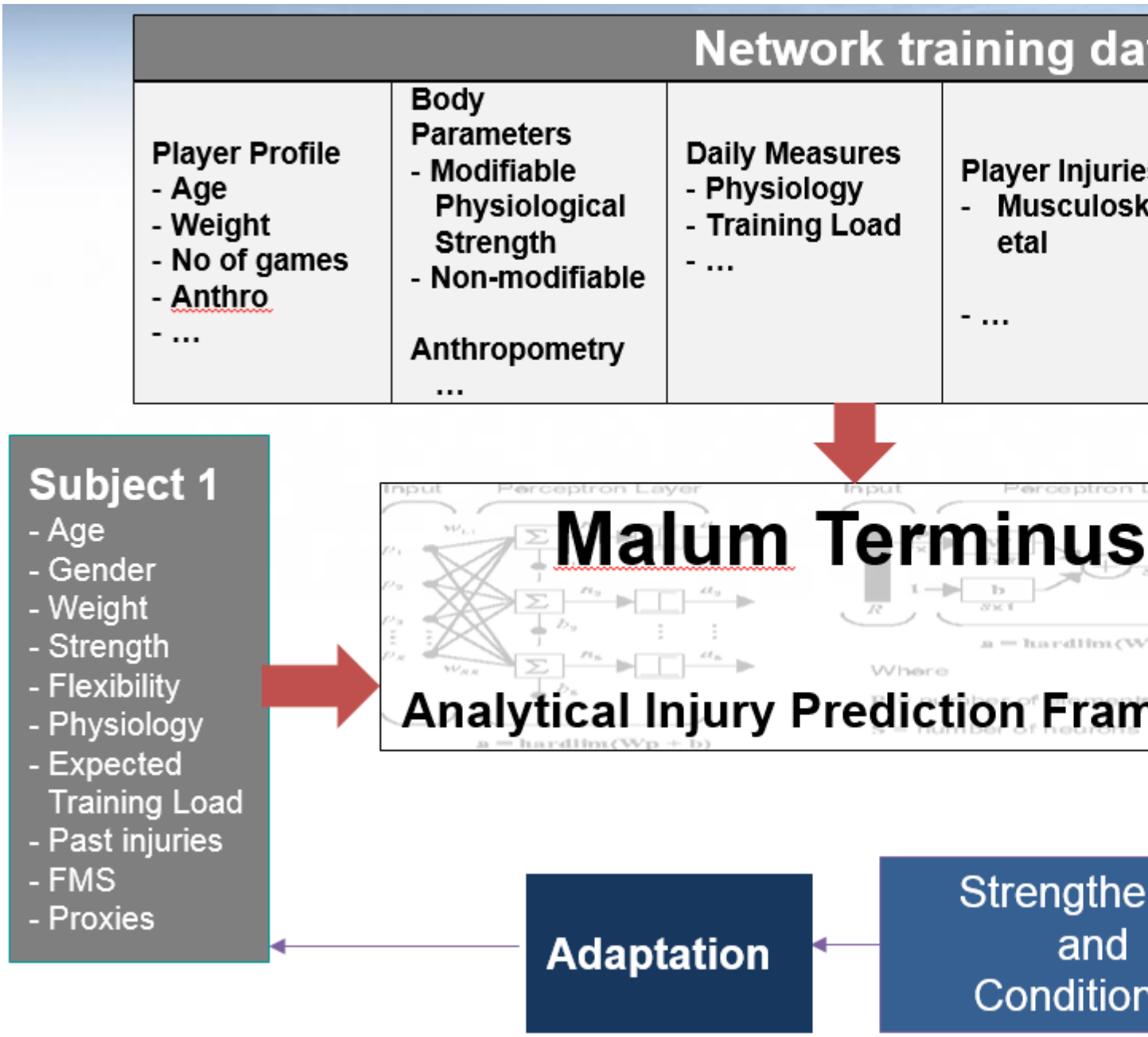
In one simulation of actual data from a UI female athletic team, the following findings were discovered:

> "Injuries for specific players occurred when sleep, stress, and a specific amount of player load occurred." These quantified parameters indicated a specific ACL injury.

MALUM TERMINUS is an individualized **injury modeling architecture** and associated simulation environment that takes into account a large number of influencing factors, both physiological and biomechanical.

- Data collection from the athletic team incorporates a large number of factors including devices and systems such as Catapult® and Omegawave®, to stress levels, sleep parameters (quality and duration), wellness, and injury data.

- We have run simulations for a specific athletic team that had 30 MSK injuries over a season and have full access to athletic data
- Task identification: We have made significant advances in transforming training load data representing training loads into a sound understanding of the biomechanics of the athlete. This was achieved by an understanding of the signature of the movement, by creating a deep learning algorithm coupled with a library of motions for each player position.
- Furthermore, the player's signature is transformed into an analytical method using predictive dynamics to obtain a full understanding of the biomechanics. This was achieved by taking in raw IMU data from a player signature into full body kinetic analysis (kinematics and dynamics).
- This method, we believe, is sound and has led to interest by Catapult®. They are interested in partnering, licensing the technology.
- We developed a new set of kinetic injury-specifics metrics. For a specific MSK injury, and we have considered ACL, we have delineated 10 biomechanical metrics that are most influential for the ACL injury.
- The *MALUM TERMINUS* simulation environment now includes all of the above components.


Network training da
Player Profile
- Age
- Weight
- No of games
- Anthro
- …
Body Parameters
- Modifiable Physiological Strength
- Non-modifiable
Anthropometry
…
Daily Measures
- Physiology
- Training Load
- …
Player Injurie
- Musculosk etal
- …
Subject 1
- Age
- Gender
- Weight
- Strength
- Flexibility
- Physiology
- Expected Training Load
- Past injuries
- FMS
- Proxies
Malum Terminus
Analytical Injury Prediction Fram
Adaptation
Strengthe and Condition