Neural Networks - Muzzle Velocity Prediction

CHALLENGE

Decilog was asked to develop software for predicting muzzle velocity for a series of artillery systems, including the Paladin Howitzer. Muzzle velocity prediction is an inherently difficult task because of having to model complex, nonlinear, time-dependent interactions.

APPROACH

In order to meet the stringent requirements, Decilog developed a Modified Associative Recurrent Neural Network (MARN). The MARN enables operators to predict muzzle velocity or muzzle-velocity variation of the next round to be fired, based upon the following factors:

- the current state of the weapon
- the current state of the projectile
- recent history of the weapon and projectile
- prior muzzle-velocity data from on-board sensors
- the time intervals between firings

Inputs to the prediction software come from a suite of on-board sensors that monitor a series of attributes. These sensors identify and report on the following significant factors:

- weapon and projectile state parameters
- projectile type, weight and charge zone
- actual muzzle velocities from prior firing
- tube and charge temperatures

The MARN prediction software was initialized using one set of data provided by the client, and a demonstration was then conducted on a separate set of data, also supplied by the client.

BENEFITS

A key characteristic of the MARN system is that it reduces anomalies that might occur in the input data.

Decilog's MARN software requires input data from only one prior round since a "context layer" accounts for results from earlier rounds.

RESULTS

The demonstration of the MARN prediction software was successful in that it achieved a high correlation between the predicted muzzle velocity and the actual muzzle velocity extracted from client data.