MSF test scenario

Scenario Description

The MSF test scenario is a simple rover mission on simulated Mars terrain. A single rover is situated near a fairly flat landing site and is scheduled to perform simple exploratory tasks.

Tasks

- Before starting the mission the rover gives an update of its power resources.
- The rover determines its orientation.
- The rover takes a panorama picture.
- The rover takes a narrow field of view picture of an area that contains a rock, which is assumed to be of volcanic nature (basalt). The close-up image reinforces the assumption that the rock is of volcanic origin. The rock is located about seven (7) meters from the rover.
- The rover takes a thermal emission spectrum of the rock (TES) to determine the material composition. The data reveals a high content of basaltic material.
- The rover orients itself toward the target rock.
- The rover engages its NavCam to determine if the path is free from obstacles. The path contains some small rocks but is otherwise free from obstacles for the next four meters.
- The rover moves about halfway (4 meters) toward the rock and relays an update of position, orientation, and power resources to the command center.
- It turns out that the rover miraculously stayed on course.
- The rover records a second NavCam picture. The path is free of obstacles.
- The rover continues to move toward the rock and stops a few inches in front of it.

Models

- Terrain:
  - Dimension: 60 x 100 meter.
  - Resolution: area in the center (20mx60m) high resolution; surrounding area low resolution.
  - Features: one impact crater; variable rock density distribution; variable rock size distribution.
  - Texture: can be synthetic but should look realistic.
  - Simple representation of properties (e.g. pointing a TES at various locations returns the spectrum of that area (or object).

- Rover:
  - K9 rover
  - Low to medium resolution CAD representation
  - Rover is defined in a file
  - A kinematic model keeps the wheel on the ground
  - Possibly includes a dynamic model.
  - Rover can be controlled by high-level commands

- Sensor
  - A simple sensor determines rover orientation.
  - Information about motor states is also available but the info comes from the "ControlledMotor" class rather than from a separate sensor module (In other words, ControlledMotor contains a sensor).
  - The NavCam is a camera with a 45x45 deg. Field of view.

- Equipment:
  - Simple model of a PanCam with 16x16 deg. field of view. (A panorama is a sequence of pictures.)
  - Simple model of Thermal Emission Spectrometer (e.g. Mini-TES).

- Resource:
  - The model can be queried for power requirement for each component.
  - Each component uses power at a constant rate when engaged.
  - For simplicity, the solar panel produces a constant level of power regardless of the solar angle or the rover's orientation.
  - The model computes the total power consumption and that of the various sub-components.

- Autonomy:
  - Rover mission control (May be a simple script or an available module that can be interfaced with MSF).
  - Rover path planner. (Can be as simple as to orienting itself toward a target and approaching the target in a straight line. If possible, use a more advance model coupled with obstacle avoidance.

MSF capabilities and features demonstrated by the scenario

General:

- A complete simulation consisting of various federates can be created with minimal programming.
- Detailed knowledge of the High Level Architecture (HLA) is not required. The Federate Tool Kit (FTK) hides those details from the user.
- A simulation executive enforces time management and allows the user to control (start, stop, continue) the simulation.
- A viewer that allows viewing the various models while they interact during a simulation.
- Data exchanged among the various federates can be collected and analyzed.

Model specific:

- The terrain model is capable of representing various terrains, either generated from (real) mission data or generated by synthetic means.
- MSF will contain a model of a Mars rover including physical representation of CAD model, kinematics and possible dynamics models, motors and high-level interface (e.g. “move-to”). If possible path planning and obstacle avoidance modules will be integrated if they become available.
- A simple power resource model keeps track of the state of the batteries and the use of power by the various rover and instrument components. If possible, a more advanced resource model will be used if it is feasible.
- A simple sensor model demonstrates its interaction with other components in the simulation. The sensors used in this scenario give information about the state of the rover.
- The PanCam is a representative of an on-board instrument. It will be capable of taking a sequence of pictures that represent a panorama.
- The Infrared Point Spectrometer (e.g. Mini TES) model demonstrates the return of science data from the environment. The initial model will be a simple pointing device that queries data from the terrain. The terrain will have pointers to a database of IR spectra that represent the material composition of the terrain. Later, a more advanced model, such as the one developed by Meemong Lee’s group will replace this simple model.
- The moving rover demonstrates physical (and dynamics) functions of the rover model tests the obstacle avoidance algorithm.