



**Ain Shams University**

**Faculty of Engineering – ICHEP**

**Computer Engineering and Software Systems**

CSE483: Computer Vision

Project Phase 1

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## 1. Drive Rover Methods

### Rover State Init Function

Initializes the “Rover State” class that contains the following variables:

- Start time of navigation
- Total time of navigation
- Images captured by camera
- X and Y positions of robot
- Yaw, pitch, and roll of robot
- Current velocity, steer, throttle, brake value of robot
- Angles and distances of navigable terrain pixels
- Ground truth world map
- Current mode
- Throttle setting in acceleration
- Brake setting when breaking
- Threshold to stop/go forward
- Maximum velocity
- Vision image and world map
- Sample: positions, initial count, number on map, number collected
- Near sample flag, picking up flag

### Telemetry Function

A method that executes 25 times per second to continuously update the Rover’s state. Each time it is executed, it executes the perception step and decision step methods.

## 2. Decision Method

### Decision Step Function

It acts as the program’s decision-maker. Depending on the Rover’s navigation angles, mode, and velocity, the decision step function decides whether to throttle, coast, stop, release brake, pickup rock, etc.

## 3. Perception Methods

### Color Thresh Function

A function that takes in the image and obtains the navigable terrain from it by identifying all pixels above all three RGB threshold values.

### Rover Coordinates Function

A function that converts image coordinates into rover coordinates by taking in a binary image and calculating pixel positions with reference to the rover position at the bottom-center.

### Polar Coordinates Function

A function that converts rover coordinates into polar coordinates by taking in x and y pixel values and calculating the distance to each pixel as well as the angle away from vertical for each pixel.

### Rotate Pixel Function

A function that rotates the rover's axes to match the axes of the world using the yaw rate of the robot. The goal of the function is to make the rover x and y be parallel to the world x and y.

### Translate Pixel Function

A function that applies a specific scaling and translation amount on the rotated pixels that are outputted from the Rotate Pixel Function. The scaling adjusts the size of objects in the world and the translation repositions the rover x and y so that they have the same origin as the world x and y.

### Pix to World Function

A function that calls the Rotate Pixel Function to apply rotation, then calls the Translate Pixel Function to apply scaling and translation, then applies clipping onto the pixel values and returns the x and y values of the pixels mapped onto the world.

### Perspective Transform Function

A function that takes in an image, source points (4 points from the on-ground view of the robot), destination points (the same 4 points as the source but from the bird's eye view) and uses them to generate a filter mask to be applied on the full image to get a warped perspective of the image.

### Perception Step Function

A function that applies/executes the aforementioned Perception functions in succession and updates the Rover's values.

## 4. Supporting Methods

### Update Rover Function

Updates the values of the variables of the rover mentioned above and then prints them on screen.

### Create Output Images Function

Takes the output images and displays them on the simulator to create a scaled map. It also creates some statistics about the map and rock detection results and displays them. These statistics include: time elapsed, mapping percentage, fidelity, number of rocks collected, etc.

### Convert To Float Function

A supporting function that converts strings to floats.