A.R.E.S. Autonomous Traversal Task Plan

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We can break the working of this plan into various major blocks as specified in the plan provided . The output of one block may or may not serve as an input for another block.

I think this plan is for the autonomous traversal . All the hardware and software logic explained is more or less related for the working and the enhancement of the traversal of the rover .

SENSOR FUSION (Combination)FOR DRIFT CORRECTION

The purpose of this block is clearly specified in the name , as it uses information from various sensors which in this case are accelerometer , which reports the accelaration of the body in the respective direction , gyroscope this gives us the information about how much the device is rotating about the respective axises and magnetometer which gives us the heading in a plane similar to compass , which are embedded on MPU 9250 which provides 9-DOF(degree of freedom) for drift correction. All the infromation gathered from this sensors can give us the information about how the body is moving and facing in a 3D space .

The inputs from this sensors servers as an input for the Kalman Filter . Kalman Filter is an optimal estimation algorithm .

Their are two Kalman filters in the plan.

* For the drift correction in the yaw , pitch and roll ,which are the rotational parameters .
* Second one is for the correction in IMU(inertial measurement unit) and GPS.

The former one recieves input from the visual odometry and later recieves input from the gps(latitude and longitude).

The corrected value are given as output .

Looking at the output there are two coordinates for the representation which suggests that it is assumed to move in a 2D plane. But here I think the y coordinate should have been considered due to the curvature , though the change will be negligible bt should have considered to represent the global and local variable.

LOCALISATION THREAD :

STEREO VISUAL ODOMETRY:

Stereo setup:

There are two cameras for the stereo input , which i expect to be placed in mutually opposite direction inorder to cover the 360 degree (2D)aspect as much as possible.

The stereo set up also has its own coordinate system defined known as the camera coordinate system which should be defined by a normal vector and the plane containing them.

The stereo camera serves as an input for the stereo visual odometry.

OpenCV has been used in the visual odometry part:

some of the functions feature\_detector() and solvePnp() which is used to get the pose of the object that has been served as an input by the stereo inputs.

OpenCV is a good choice for image processing since the wide variety of functions availabel makes it lot more easier as compared to other library.

GLOBAL MAP REPRESENTATION:

Here we get the global coordinates of the rover and other states like the rover velocity , heading direction .

Local and global states together represent the rover position . The global coordinates and the velocity are given by Kalman Filter and the local by the local\_map\_optimization().

LOCAL MAP OPTIMIZATION :

The 3D geometry acquired from the images taken from multiviews by structure from motion approach . Then ,the 3D point data is regarded as the input of the sparse bundled adjustment technique in RANSAC framework.A random walk model is proposed to relocate the back projections of 3D points which are also one of the inputs of the optimization algorithm, so as to improve the optimization results further.

OBSTACLE DETECTION AND MOTION PLANNING THREAD :

Obstacle Detection , in this input comes from the two stereo inputs (camera) . In obstacle detection also some of the OpenCV built in functions have been used.

The stereoSGBM() is used for depth generation and filtering using python

Motion Planner , here we have some built in functions to get the speed and direction of the rover which we have calculated in different blocks and it also uses the obstacle detection for its purposes . The ROS node is used for the motion control.

CONCLUSION:

The stereo inputs can be enhanced to cover 360 degree in 3D , inplace of placing the two stereo inputs in opposite direction(assumption).

An infrared sensor can be used to detect the objects around it .