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Title: Attitude Determination of Land Vehicle Using Inertial Measurement Unit

Functional Description

The following project will be placed eventually onto the body of a land-based vehicle to determine the attitude of the vehicle with respect to the local coordinates. This attitude and position determination can be used to supplement a global positioning system in time when there is no line of sight to GPS satellites maintained. Our system can record the movement of the vehicle to prevent it from leaving a set course or from moving into an unstable or dangerous environment. This system may help a driver by triggering increased traction control and air bag deployment, as the accelerations and attitude angles change while driving.

Inputs:
3 outputs from accelerometers which provide accelerations along the x, y and z axes with respect to the body of the vehicle $\Delta f_{x,y,z}$

3 outputs from gyroscopes which provide attitude angles with respect to the body of the land vehicle $\Delta\omega_{\alpha,\beta,\gamma}$

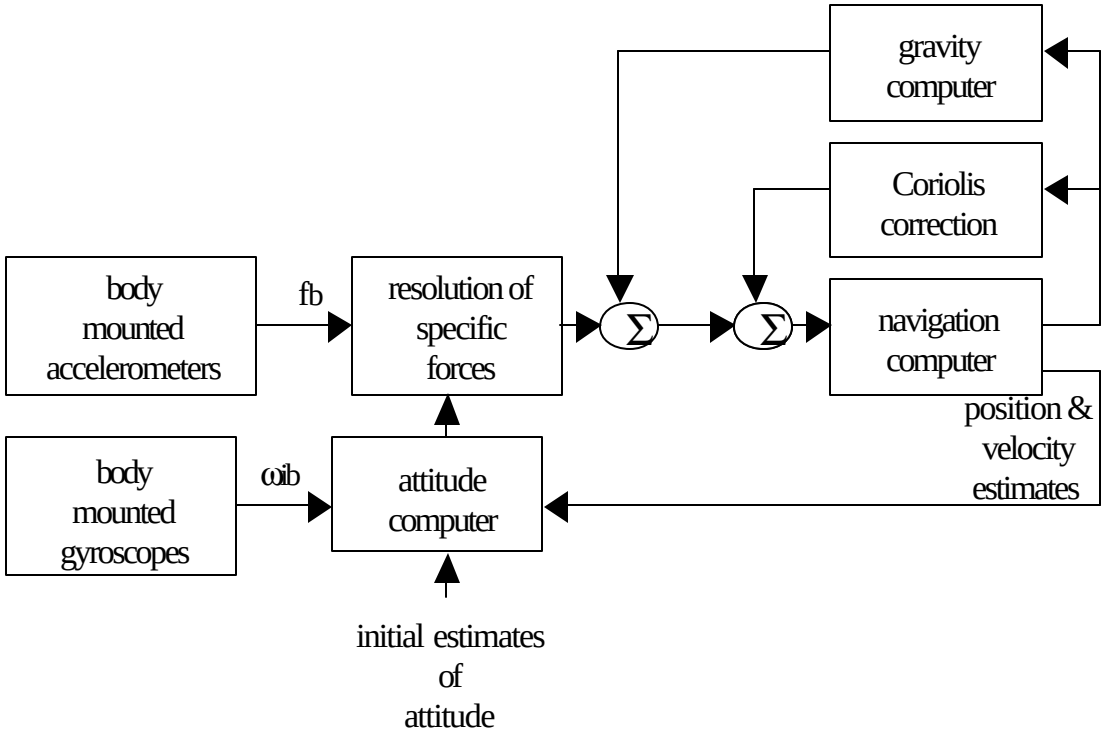
Initial estimates of attitude, which come from the initial position and angles of the vehicle

Outputs:
Position in local navigational (NED) coordinates

Velocity in NED coordinates

Acceleration in the NED coordinates

Euler angles with respect to NED coordinates



Strapdown solution in navigation frame (local North-East-Down frame)
ωib is the angular movement of the land vehicle
fb is the acceleration of the land vehicle

Modes of Operation:

Movement of the system causes the three accelerometers and three gyroscopes to produce outputs, translational accelerations and angular rates along the x, y, and z axis of the system. The acceleration values are integrated with the inclusion of attitude information yielding velocity and position. Also, the attitude angles $\{\alpha, \beta, \gamma\}$ are obtained by integrating angular rates, $\Delta\omega_{x,y,z}$. The attitude angles are used to determine the body coordinates with respect to the local coordinates. These six values are converted to North, East, and Down coordinate system, which corresponds to a local navigation system. Using the initial estimates with the six calculated values, new attitude and position coordinates are obtained and updated.