

3rd IAA LATIN AMERICAN CUBESAT WORKSHOP

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DATA ACQUISITION FROM CUBESAT – FACENS³





LSM9DS1

Description

- Three-dimensional linear acceleration digital sensor
- Three-dimensional angular rate digital sensor
- Three-dimensional magnetic field digital sensor
- Thermometer digital sensor

Benefits

- Low power mode

Disadvantages

- Don't have the necessary thermal characteristics, requires a thermal protection



ISL29102

Description

- Low Power Ambient Light-to-Voltage Non linear Converter
- Identify the sun

Disadvantages

- Don't have the necessary thermal characteristics
- Imprecise aperture angle



Imprecision problem

Vibration

Delay in the measurement

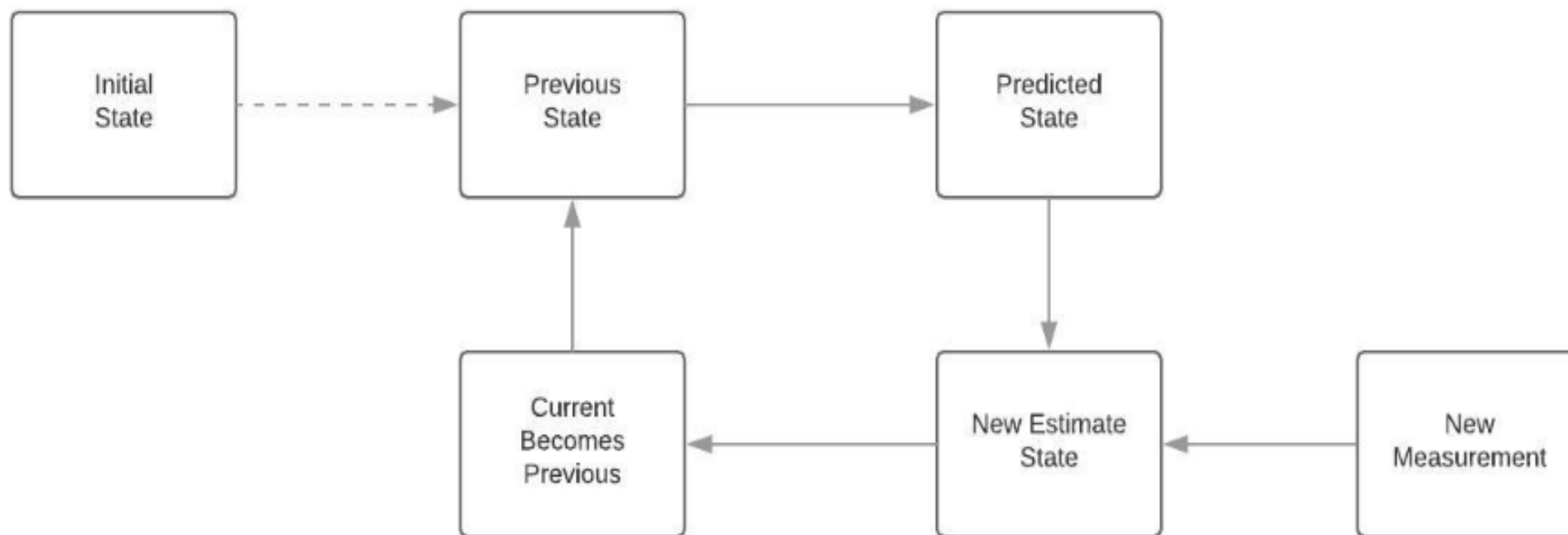
Incompatibility in the electrical system

Electromagnetic interference

And so on....



Kalman Filter





Predicted State

In the prediction phase the system determines the prediction for the state matrix (X_{k_p}) and state covariance (P_{k_p}), through the following equations:

$$X_{k_p} = A * X_{k-1} + B * \mu_k$$

$$P_{k_p} = A * P_{k-1} * A^T + Q$$



Updated State

In the update phase the system calculates the Kalman gain matrix KG_k and updates the state and covariance matrices of the process.

$$KG_k = P_{k_p} * H^T * (H * P_{k_p} * H^T + R)^{-1}$$

$$X_k = X_{k_p} + KG_k * (Y_k - H * X_{k_p})$$

$$P_k = (I - KG_k * H) * P_{k_p}$$

Reaction wheel model

$$\begin{aligned}\theta_k &= \theta_{k-1} + \dot{\theta}_{k-1} * \Delta t + \ddot{\theta}_{k-1} * \frac{\Delta t^2}{2} \\ \dot{\theta}_k &= \dot{\theta}_{k-1} + \ddot{\theta}_{k-1} * \Delta t\end{aligned}$$

$$\begin{bmatrix} \theta_k \\ \dot{\theta}_k \end{bmatrix} = \begin{bmatrix} 1 & \Delta t \\ 0 & 1 \end{bmatrix} X \begin{bmatrix} \theta_{k-1} \\ \dot{\theta}_{k-1} \end{bmatrix} + \begin{bmatrix} \frac{\Delta t^2}{2} \\ \Delta t \end{bmatrix} X \left(-\frac{\ddot{\theta}_r * I_r}{I_s} \right)$$



Conclusion and future Works

- The cubesat projected requires a thermal protection or sensors appropriate to the temperature of the space
- Use more light sensors working together with the camera
- Update the data treatment to use computer vision to the image
- Update the determination of the system and attitude control to operate in three-axis



Any Question ?

Thank You !



Team:

Aliffy Benevides - aliffy.benevides@outlook.com

Beatriz Mendonça - beacristinamm@gmail.com

Mariana Kawachi - marykwch@gmail.com

Mauricio Bonato - mauriciojandir@gmail.com