Using AI onboard of small satellites

Open Source Cubesat Workshop 2018 - ESAC (Madrid)

Motivations

- Number of small sats and constellations increasingly growing.
- Embedded devices are getting more powerful and efficient **(edge computing)**, which opens an opportunity for Cubesats to reach an unprecedented level of autonomy.
- There are many solutions in this market but it's difficult to compare them on paper.
- Reveal how propriotary hardware behave so that anyone creating open source computing hardware can compare and have key performance indicators.

Applications

We can leverage AI to react faster, reduce data link usage and in general increase spacecraft's autonomy. Some more specific scenarios are:

- Automate satellite operations.
- Identify complex time-series and detect anomalies in telemetry.
- Analyze data onboard.
- Autonomous coordination of sat constellations
- Deep space missions.

(Write down your ideas below)

Join the workgroup session "Satellite On-Board Artificial Intelligence" with Xabier Crespo to discover more applications.

Improving this research?

- Use resistors smaller and with less tolerance.
- Configure the oscilloscope to use more significant figures when exporting data as well as to increase the number of samples.

Some engineers are using +1000€ wattmeters to measure how many pJ each mathematical operation of a DL network takes. With improvements mentioned above we could obtain those kind of measurements with a relatively low cost setup (~300€).

Future work

- Obtain some telemetry data and use this hardware to analyze it and detect anomalies.
- Run Inception on an ARM M4 processor using uTensor. Convolution is not supported yet but the project is open source.
- Find a challenging battery-powered project that we can solve using this hardware (maybe something for NASA's Space Apps Challenge).

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