Experience at ESOC in orbit determination and on-going research in drag modeling

Pere Ramos Bosch

ESA ESOC

13/05/2022

ESA UNCLASSIFIED – For ESA Official Use Only

Experience of ESOC in orbit determination

- Current fleet of 16 satellites Earth Orbiting satellites covering a wide range of altitudes.
- Two of the most interesting ones in drag modelling:
    - AEOLUS (at 315km of altitude).
    - GOCE (Reentry on 2013, with data going down to 150km).

Experience in GOCE

Experience in AEOLUS

The issue of density estimation

Why?

The issue of density estimation

Sources:

Drag Model

Solar indices

Drag coefficients

CD estimation -> absorbs missmodelings

Solar indices used at ESOC PDFLAP

		Day+1	Day+2	Day+3
F10.7	m	0.1	0.2	0.2
	RMS	3.4	4.4	5.3
Ap	M	-1.2	-1.9	-2.4
	RMS	7.3	8.4	8.7

Evolution of CD for several satellites

Current research at ESOC

Drag Model

Solar indices

Drag coefficients

Current research at ESOC – Drag modeling

- Model used: NRLMSISE00.
- Application of AI/ML techniques to improve it.
- Two approaches with Reduced Order Model (ROM):
  - **Full model**: Maximum fidelity, to be enhanced with trajectories of operational satellites.
  - **Simplified model**: Reduced computing cost -> Useful for long term predictions of complex month-long optimisations.

Current research at ESOC – Solar indices prediction

- Not very successful! Not better than the current PDFLAP…
- Even though predictions lag a bit behind (as expected).
- The real break through would be to use other inputs, such as predecessors (sunspots…).

Current research at ESOC – CD prediction

Current research objectives & next steps

- How can we **improve** orbit **predictions** for **low altitude** satellites?
  - Better drag model?
  - Better solar indices prediction?
  - CD predictions for satellites?

- Current work:
  - **Integrating predictors** into our **propagation software**
  - **Low processing power – high fidelity AI/ML density model.**

Questions?

Pere Ramos Bosch
ESA/ESOC
pere.ramos.bosch@esa.int