LEOP and chemical maneuvers

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LEOP: two missions studied

Common characteristics:

- 1-2 impulse maneuvers with chemical propulsion
- Magnitude and direction errors on maneuvers
- Small initial covariance

Collision risk computation should be anticipated for 24h to 36h after the first maneuver

For operational reasons, magnitude can vary from low intensity (a few mm/s) to high intensity (order of m/s)

Problematic:
What is the validity domain of traditional risk computation methods, depending on the maneuvers magnitudes?

Maneuvers characteristics

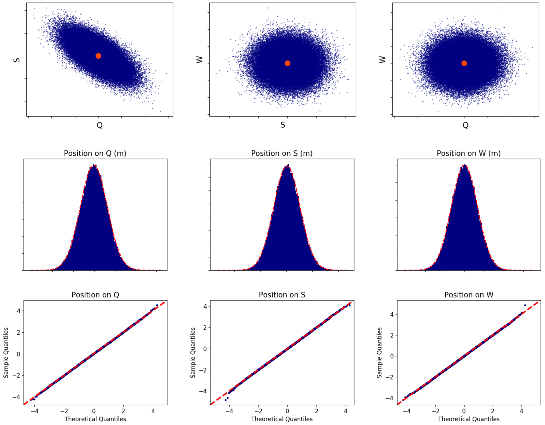
Satellite 1

- 1 maneuver
- $\Delta \boldsymbol{V} \in [0; 0.3]\ m/s$
- $3\sigma_{\mathrm{mag}} = 5\%$
- $3\sigma_{\mathrm{dir}} = 0.15°$

Satellite 2

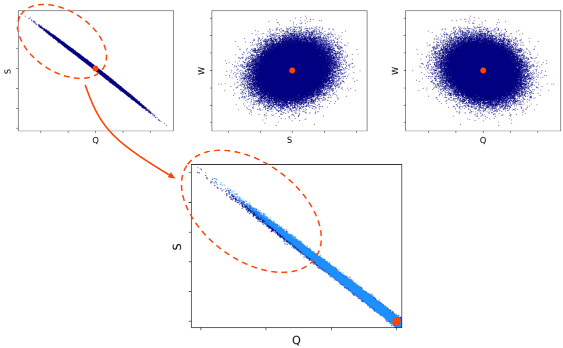
- 2 maneuvers
- $\Delta \boldsymbol{V} \in [0; 4]\ m/s$
- $3\sigma_{\mathrm{mag}} = 5\%$
- $3\sigma_{\mathrm{dir}} = 5°$

$\Delta V \propto 10\,\mathrm{mm\,s^{-1}}$, 24-36h propagation



Gaussianity confirmed for very small values of ΔV for both satellites

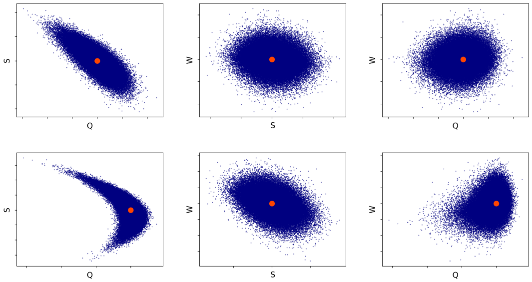
$\Delta V = 0.3\,\mathrm{m\,s^{-1}}$, 24h propagation



Gaussianity slightly lost for higher values of ΔV

SATELLITE 2

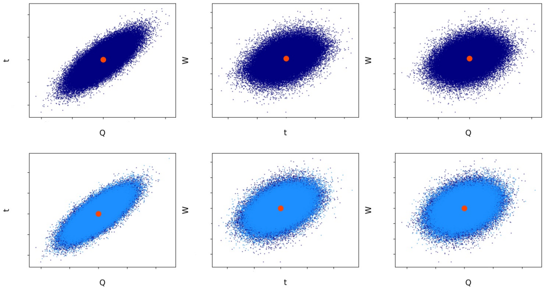
$\Delta V = 0.5\,\mathrm{m\,s^{-1}}$ to $4\,\mathrm{m\,s^{-1}}$, 36h propagation



Gaussianity lost for higher values of $\Delta V \Rightarrow$ **QtW?**

Representation in QtW coordinates

$$\Delta V = 4\,\mathrm{m\,s^{-1}}$$

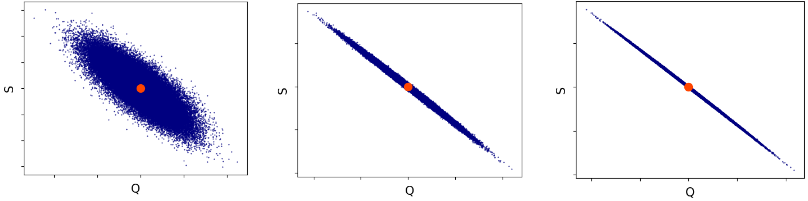


Differences between Monte Carlo and STM propagations negligible

No matter how similar two cases seem...

Conclusions will never be the same

After 24h of propagation and a total ΔV of $0.2\,\mathrm{m\,s^{-1}}$:



Slight difference on initial covariance or maneuver error
$\rightarrow$ very large impact on propagated uncertainties

Thank you for your attention

(again)