Searching for the optimal dual gravity satellite missions

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GI, Stuttgart

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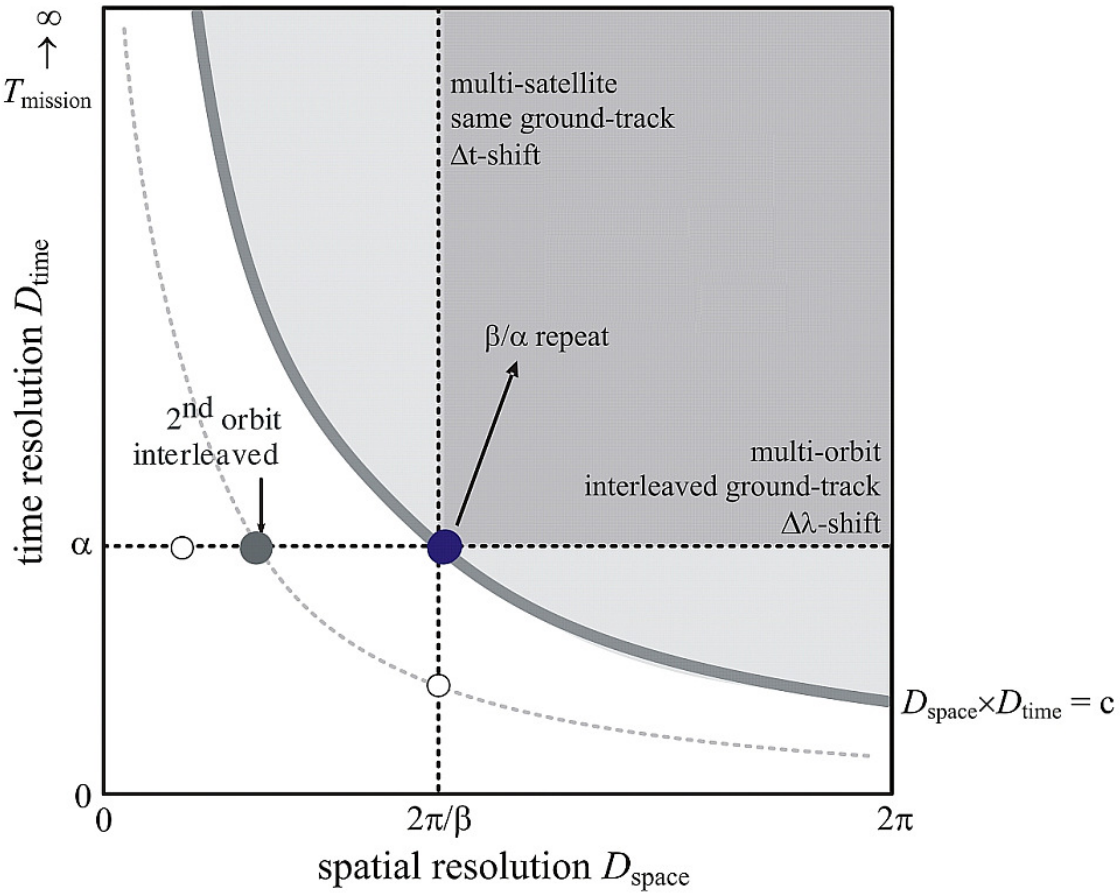
Make use of (modified) Colombo-Nyquist rule for spatial resolution!

$\beta \geq 2L_{\text{max}}$ ($\beta \geq L_{\text{max}}$)

Heisenberg-type principle

Space-time sampling of satellite configurations

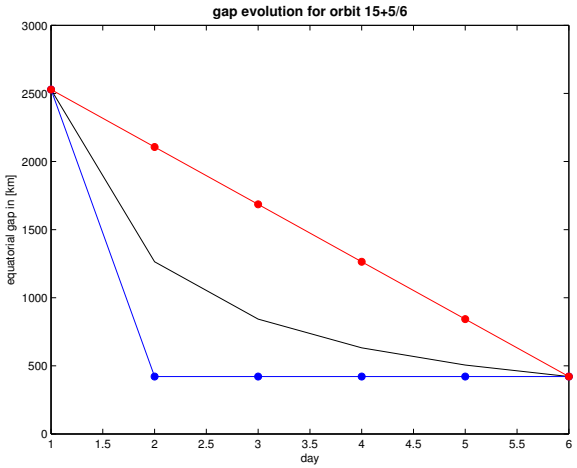


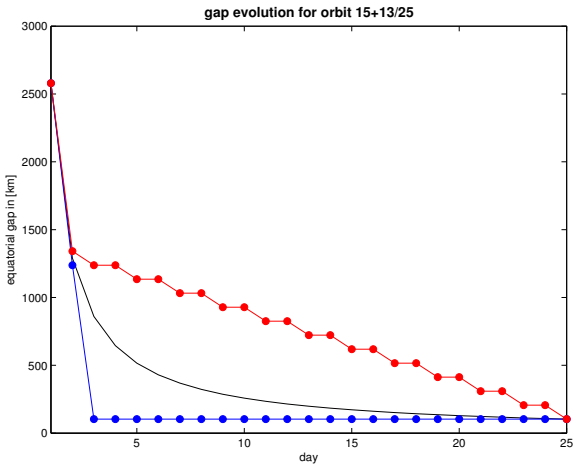
ESA 2007

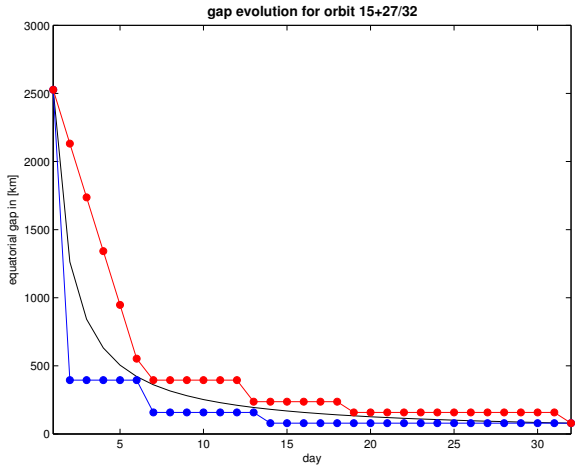
Ground-track effect (Gap evolution)

Single pair

at equator



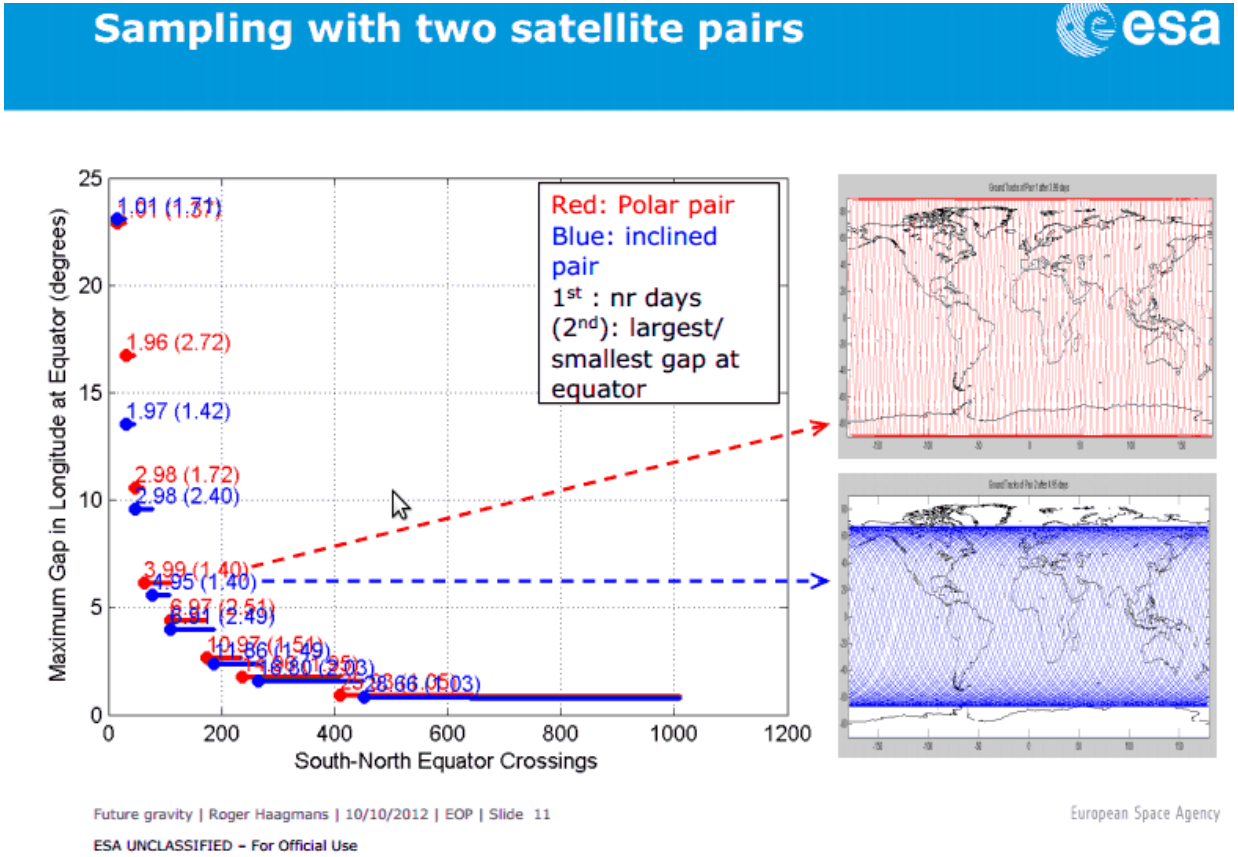




gap evolution behaviour of a drifting orbit (left), a slow skipping orbit (middle) and a fast skipping orbit (right)

Ground-track effect (Gap evolution)

Double pair



Courtesy: ESA's Studies of Next Generation Gravity Mission Concepts for Observing Mass (Luca Massotti, Roger Haagmans, Christian Siemes and Pierluigi Silvestrin; IAG Gravity Field Symposium, Venice, Italy, 2012)

Repeat orbit aliasing!

Single inline satellite pair

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GRACE analysis

Altitude evolution h(t)

↓

basic angular velocities

$\left(\dot{u}(t), \dot{\Lambda}(t)\right)$

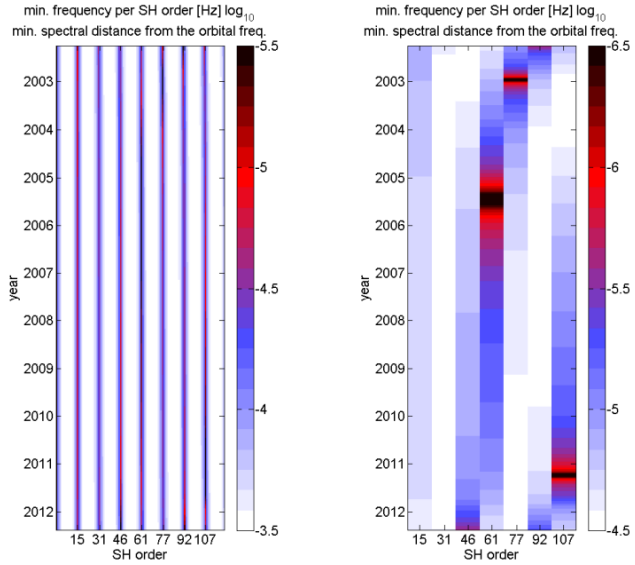
↓

Frequencies per order

$\omega(m) = k\dot{u} + m\dot{\Lambda}$

↓

Min. frequencies per order



Courtesy: Optimal repeat orbits for temporal gravity recovery with future low-low SST formations, M. Murböck et al.; GGHS2012, Session 3: Future Gravity Field Missions

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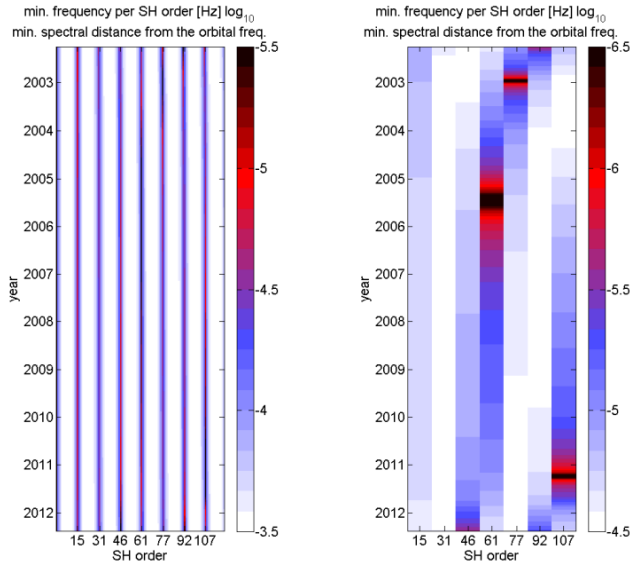

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Double pair?

Optimization of orbital parameters

(searching for optimal missions)

Searching for optimal missions

Examples

Searching for optimal missions

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Global geoid height error rms for 3-day, 6-day and 32-day recoveries of different dual inline formation mission scenarios ($L_{max} = 90$).

scenario	β/α [rev./day]	inclination [deg.]	altitude [km]	error rms [mm] 3d	6d	32d
1	503/32 503/32	89.5 72	333.8 305.0	0.8	0.4	0.2
2	125/8 503/32	89.5 72	360.7 305.0	0.9	0.4	0.2
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Recovery errors of 3, 6 and 32-days of scenarios 5; Different $\Delta\Omega$ [deg.]

$\Delta\Omega$	error [mm] 3d	6d	32d
0	1.7	0.7	0.3
90	1.7	0.6	0.3
180	1.3	0.7	0.3

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- Accuracy (lower noise level)

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Monte Carlo algorithm

Searching for optimal missions

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- Characterization of the mission performance, P, given two pairs of collinear satellites, via the following

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- Consideration of science requirements and technical challenges for altitude, intersatellite range, ...

Simulations!

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- Implement GA algorithm

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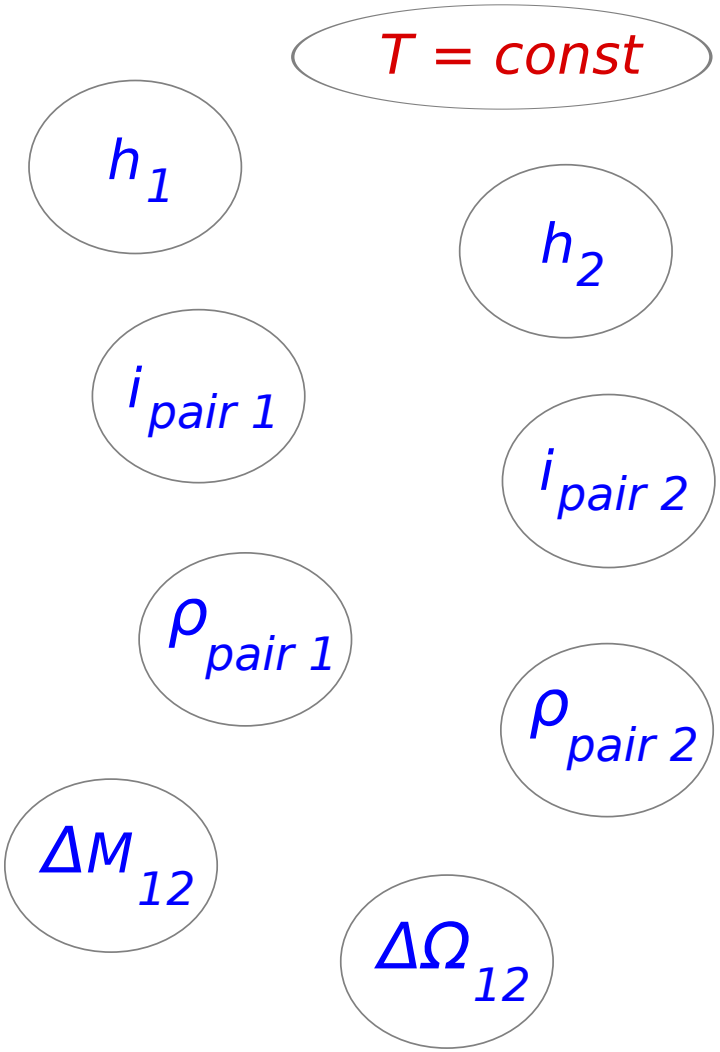

Thank you!

Questions?