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Impact of accelerometer calibration modelling on GRACE Follow-On precise orbit determination and intersatellite ranging

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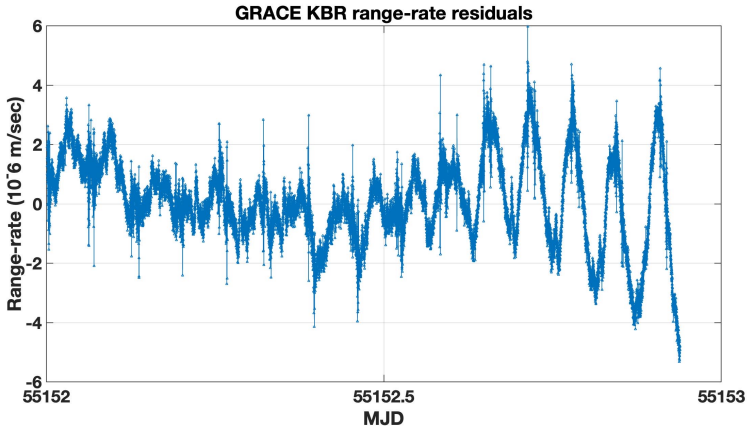
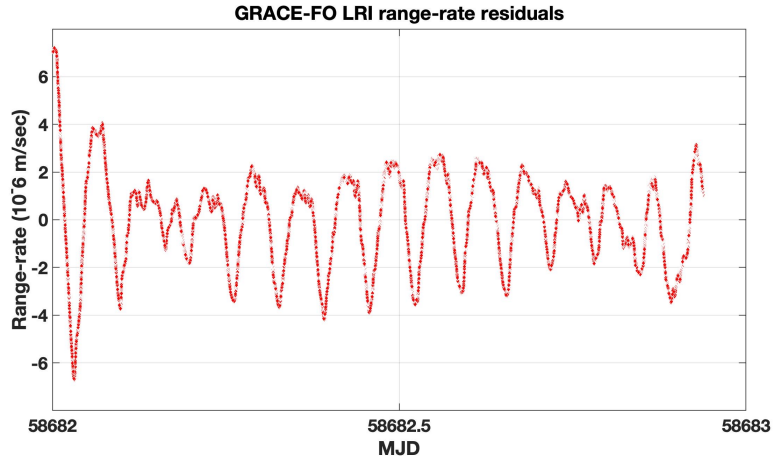
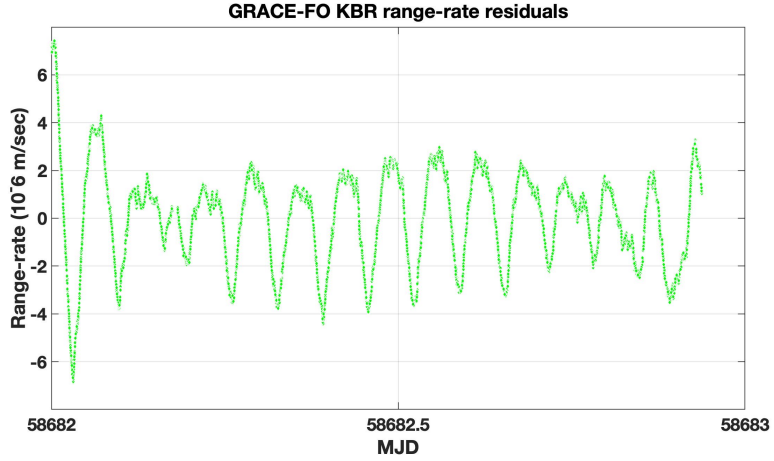
Precise orbit determination is a major objective in satellite geodesy and data analysis of several geoscientific satellite missions. Satellite gravity missions such as the Gravity Recovery And Climate Experiment (GRACE) missions (GRACE-FO and GRACE) are equipped with on-board accelerometers that form a key observation instrument for the measurement of non-gravitational perturbations at orbital altitude. The accelerometers calibration through a data processing scheme is essential for GRACE applications such as precise orbit determination, gravity field mapping and non-gravitational forces modelling.

The present study focuses on the estimation of the accelerometer calibration parameters within an orbit determination approach. We apply an adapted dynamic orbit determination algorithm with extended variational equations. The orbit parameter estimation considers accelerometry calibration parameters such as bias, drift and scale factors in combination with empirical forces of cycle-per-revolution (CPR) terms. The applied approach leads to orbit residuals within 2 to 4 cm (RMS) while the LRI and KBR range-rate data residuals vary within a few μm/sec (RMS: GRACE-FO 1.7, GRACE 1.4 μm/sec).

GRACE-FO/GRACE Orbit Determination and Accelerometer calibration modelling	
Orbit arc length / Date	1 day | 18/7/2019 - 17/11/2009
Earth Rotation	IERS Conventions 2010
EOP	IERS 08 C04
Numerical Integrator	Gauss-Jackson 12th order; RKN7(6)-8 start integrator
Integration step	2 sec / 5 sec
Pseudo-Observations	Kinematic Orbit XYZ (Suesser-Rechberger et al. 2020)
Gravity Model (d/o)	GOCO06s (Kvas et al. 2019)
Planetary Ephemeris	DE423
Solid Earth Tides	IERS Conventions 2010
Ocean Tides	FES2004
Relativistic effects	IERS Conventions 2010
GRACE-FO Accelerometers	ACC1B, Full Scale matrix (9 parameters), Bias (XYZ), Bias drift (XYZ)
GRACE Accelerometers	ACC1B, Diagonal Scale matrix (Sx,Sy,Sz), Bias (XYZ)
Empirical Forces (GRACE-FO)	1-CPR (along & cross-track), Bias-along
Intersatellite range-rate data	K-band ranging KBR1B & Laser Ranging Interferometry LRI1B







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