The twin satellite mission Gravity Recovery and Interior Laboratory (GRAIL) aims to recovering the lunar gravity field by means of intersatellite Ka-band ranging (KBR) observations. In order to exploit the potential of KBR data, absolute position information of the two probes is required. Hitherto, the Graz lunar gravity field models (GrazLGM) rely on the official orbit products provided by NASA. In this contribution, we present for the first time a completely independent Graz lunar gravity field model to spherical harmonic degree and order 420. The reduced dynamic orbits of the two probes are determined using variational equations following a batch least squares differential adjustment process. These orbits are based on S-band radiometric tracking data collected by the Deep Space Network (DSN) and are used for the independent GRAIL gravity field recovery. To reveal a highly accurate lunar gravity field, an integral equation approach using short orbital arcs is adopted to process the KBR data. A comparison to state-of-the-art lunar gravity models computed at NASA-GSFC, NASA-JPL and AIUB demonstrate the progress of Graz lunar gravity field models derived within the project GRAZIL.

**RESULTS AND MODEL EVALUATION**

- External solutions exploiting GRAIL data:
  - NASA-GSFC: GRGM660PM
  - NASA-JPL: GL0420A, GL0660B
  - AIUB: GRL200A, GRL200B

- Signal: GRGM660PM (US)
  - GL0660B (US)
  - GL0420A (US)
  - SGM150J (JAP)
  - AIUB-GRL200A (CH)
  - AIUB-GRL200B (CH)

- Iterative procedure POD - GFR:
  - a-priori Model SGM150J [2]
  - POD - S2 Release
  - Model - d/o = 200
  - 200
  - 300
  - 300
  - POD - L2
  - 420
  - 350
  - POD L5
  - 420
  - 420
  - POD N5
  - 420
  - 420
  - POD N6
  - GraziLGM420a
  - GraziLGM420a+

- Free air gravity anomalies near side (left) and far side (right):
  - GraziLGM420a

- Residual RMS of last iteration is around 1.8mHz during PM phase:
  - Residual RMS

**ORBIT DETERMINATION (POD)**

- Allows for a fully independent solution
- POD based on variational equations
- Batch least squares differential corrector (IWF software)
- DSN two-way radiometric tracking data in S-Band

Comparison to official orbit product GN11B (includes KBR data) exemplary shown for Ebb:

- Comparison to official orbit product GN11B (includes KBR data):
  - Ebb

- Post-fit residuals of DSN two-way tracking data:
  - Residual RMS

**GRAVITY FIELD RECOVERY (GFR)**

- requires absolute position of GRAIL-A (Ebb) and GRAIL-B (Flow)
- GFR based on short-arc integral equation approach
- Processing strategy inherited from GRACE (TUG software)
- Inter-satellite ranging data in Ka-Band (KBR)

Iterative procedure POD - GFR:

- a-priori Model SGM150J [2]
- POD - S2 Release
- Model - d/o = 200
- 200
- 300
- 300
- POD - L2
- 420
- 350
- POD L5
- 420
- 420
- POD N5
- 420
- 420
- POD N6
- GraziLGM420a

Free air gravity anomalies near side (left) and far side (right):

- GraziLGM420a

- Residual RMS of last iteration is around 1.8mHz during PM phase:
  - Residual RMS

REFERENCES


We acknowledge the financial support by the Austrian Research Promotion Agency (FFG) for funding the project GRAZIL.