

# RSAT/VRADミッションによる 月重力場モデリング

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#### 最新の月重力場モデルの一つ:LP100J



LP100J degree and order upto 100



Based on near-side tracking data only due to synchronous rotation of the moon.





Near-side

**Far-side** 



0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30

**Selenoid height error (m)** 

Konopliv et al., 2001



## SELENE

- (SELenological and ENgineering Explorer)
- ☆Joint lunar mission of ISAS (Institute of Space and Astronautical Science) and NASDA (National Space Development Agency ).
- ☆ To be launched in 2005 by HII-A rocket.
- $\Rightarrow$  14 mission instruments on board.
- RSAT: Direct measurement of far-side gravity field by using High-Low Satellite to Satellite Tracking
- \* VRAD: Precise orbit determination by using differential VLBI.



Main satellite

Two small sub-satellites for lunar gravity mapping mission.

VLBI Satellite (Vstar)

Relay Satellite (Rstar)

### Three satellites constellation



#### **Combination of high**, middle and low altitude satellites

**Gravity field retrieval** through wide-range of wavelength.

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- Main Sat: 100km × 100km Vstar 100km × 800km
- Rstar
- :100km × 2400km



## 2-way Doppler measurement



### 4-way Doppler measurement



## Differential VLBI measurement



## VLBI ground stations



Foreign stations will participate 2 months among 1-year mission period.
Shanghai and Wetzel stations will also be used.



# Analysis condition

- Numerical analysis by using GEODYN II, SOLVE software.
- Start from LP100J clone with noise.
- Gravity coefficients up to degree and order 75.
- Mission duration : 1 year since the launch.
- Visibility condition including antenna beam pattern is taken into account (El. cutoff angle = 15 deg).
- UDSC antenna sharing plan is taken into account (6 hours/day on average for SELENE).

# Analysis condition

- 4-way Doppler and DVLBI measurements are available when Rstar is fully sun shined during a whole revolution (200 days).
- Operational limitation on ground VLBI station is taken into account (3 days/week, 8 hours/day).
- Arc length is set to be 1 day for the main satellite, and 15 days for Rstar & Vstar.
- Foreign VLBI stations are included in two VLBI campaigns (one month duration each).

# Doppler data coverage of main satellite



#### Doppler and VLBI data coverage of Rstar



### Error spectrum



Rstar 2WRR Rstar 2WRR + DVLBI Rstar 2WRR + DVLBI + main sat 2WRR Rstar 2WRR + DVLBI + main sat 2WRR + main sat 2WRR + main sat 4WRR





RMS=10.1m

RMS=5.7m

観測の寄与





70 60 50 order 40 30 20 10 0 30 40 10 20 50 60 70 0 degree 0.8 0.9 0.1 0.2 0.3 0.4 0.5 0.6 0.7 1.0

With 4WRR

青:拘束条件によって解が決まっている 赤:観測によって解が決まっている

## Conclusions

- Numerical simulation has been completed under realistic conditions.
- It is anticipated that the SELENE gravimetry will improve the lunar gravity coefficients below degree 35 to the accuracy of one order of magnitude better than LP100J which is one of the current state-of-the-art lunar gravity field model.

# Thank you for your attention.

