Analysis of Aerobraking
Accelerometer Data from Mars

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What’s Going On?

- Gas prices are high in space
- Use atmospheric drag to alter orbit instead
- Operationally challenging
- Engineering or science?
Why am I talking about this?

• MGS data safely archived, analysis ongoing
• Mars Odyssey data not yet archived, I’m funded to do so
• Mars Reconnaissance Orbiter aerobraking just completed, I’ve proposed to work on that data too, announcement expected within weeks
Data Processing
\[ ma = \rho \ C \ A \ v^2 / 2 \]

- All terms except \( \rho \) are, in principle, known
- In practice, things are complicated
  - Explain messiness for each term
Acceleration -> Density

- $ma = \rho C A v^2 / 2$

Tolson et al. JSR 2005
Quick Look Report for orbit P076 --->

05-Dec-2001

P076 39 point mean

1E-1 kg km⁻³ 1E1 kg km⁻³

130 km

100 km
Results agree well with those that have been archived at the PDS.

Density and density scale height at 110 and 120 km

Inbound density at 110 km shown here.
• Thermal tides were important for MGS, what about Odyssey?
• Contrast south pole at winter (MGS) and north pole at winter (Odyssey)
• What are the smallest scale density variations?
• Test model predictions

The End
Background

• Odyssey aerobraked from October 2001 to January 2002

• “A reduced accelerometer dataset is being archived with the PDS. At the present time, it is mostly undocumented and has not undergone a peer review” – PDS website, October 2006

• Odyssey Participating Scientist Program selected “Analysis of Accelerometer Data from Aerobraking” (PI: Mendillo) proposal
Objectives

• Obtain atmospheric densities from measured accelerations
• Deliver raw data, data products (density profiles and densities at fixed altitude), and documentation to PDS
• Do some science
Validation

• Engineering papers
• Quick-Look Reports produced during aerobraking
• 110 and 120 km densities and scale heights at PDS
Ongoing Work

- Acquire high-rate ACC data
- Deal with thrusters and angular motions
- Acquire accurate $C_D$ and $m$
- Use same "sea level" as everyone else
- Validate, validate, validate
- Document, document, document
- PDS formatting