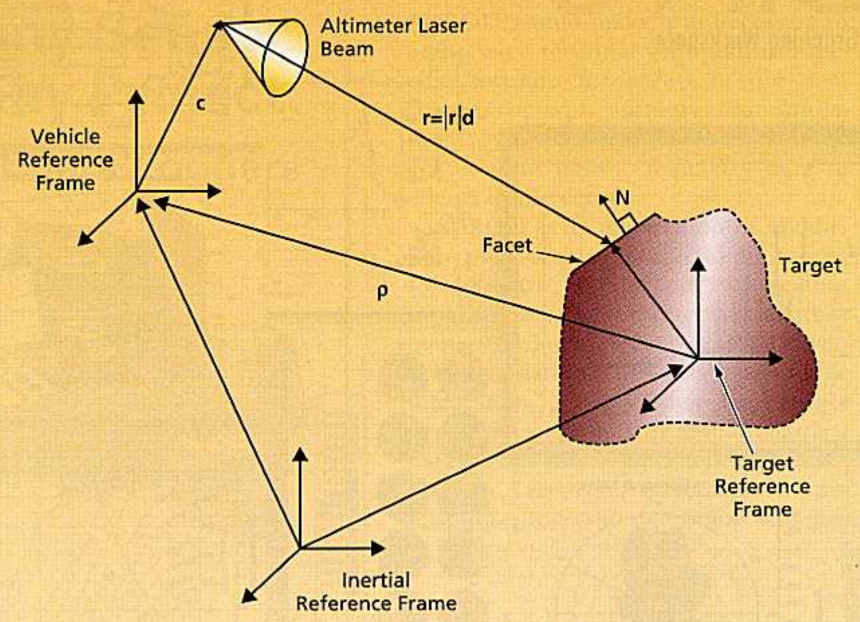
MEASUREMENT GEOMETRY



RANGE-MEASUREMENT TABLE

#	Confidence	|r|	σ	$N^T = [N_x, N_y, N_z]$	κ	$d^T = [d_x, d_y, d_z]$	$c^T = [c_x, c_y, c_z]$
1							
2							
⋮							

The **Laser or Radar Altimeter** measures the magnitude of the vector (r) from the origin of each beam to the intersection of the beam with a target body represented by a multifaceted shape model. There are multiple beams, but only one is shown here for simplicity. The measurement data and associated model data are listed in the range-measurement table.

row index (i), which is the cardinal number of the affected beam. The second column contains a number, between 0 and 1, representing the degree of confidence in the measurements. At the present state of development of the method, the confidence is taken to be either 0 (signifying complete rejection) or 1 (representing complete acceptance) of the data in the row. The third column contains the scalar range measurement $|\mathbf{r}|$ of the ith beam; the fourth column contains the standard deviation (σ) of the range measurement.

The fifth column contains the Cartesian components $[N_x, N_y, N_z]$ of the transpose of the unit vector ($\mathbf{N}^T$) normal to the model facet containing the intersection of the ith laser beam with the surface of the target object. Typically, this intersection point is not known exactly and must be estimated, on the basis of the current state estimate, by a previously developed method that lies beyond the scope of this article. The sixth column contains the facet constant, κ (the perpendicular distance from the center of mass of the target body to the affected facet). The seventh column contains the Cartesian components $[d_x, d_y, d_z]$ of the unit vector along the ith laser beam. The seventh column contains the Cartesian components $[c_x, c_y, c_z]$ of the position vector from the center of mass of the vehicle to the origin of the ith laser beam.

The entries in the RMT are mapped into a measurement equation for use by a Kalman filter that incorporates altimetry information into the final estimate of the state of a spacecraft or other vehicle maneuvering in the vicinity of a target body. The relative position vector, ρ, is part of the state vector that is updated by use of the Kalman filter.

This work was done by David S. Bayard, Paul Brugarolas, and Steve Broschart of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-44428

MODIS Atmospheric Data Handler

Stennis Space Center, Mississippi

A number of science data sets are derived from the observations of the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument onboard NASA's Terra and Aqua satellites. These data typically contain information on retrieval techniques, quality-control flags, and geo-referencing information. These datasets, distributed in HDF (Hierachical Data Format), must be further processed to extract relevant information for weather analysis studies and numerical models input. The MODIS-Atmosphere Data Handler software converts the HDF data to ASCII format, and outputs: (1) atmospheric profiles of temperature and dew point and (2) total precipitable water. Quality-control data are also considered in the export procedure.

The package currently consists of programs to process the MOD05 and MOD07 data products from MODIS. The software is written using the C programming language and contains Makefiles for easier compilation and installation. The MODIS-ADH software helps ease the overhead involved in data processing so that the numerical modelers may concentrate on their science and modeling tasks rather than manipulating data for their models.

This program was written by Valentine Anantharaj and Patrick Fitzpatrick of the Northern Gulf Institute at Mississippi State University for Stennis Space Center.

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Refer to SSC-00267, volume and number of this NASA Tech Briefs *issue, and the page number.*

Reducing Surface Clutter in Cloud Profiling Radar Data

Radar data can be processed to study clouds closer to the surface.

NASA's Jet Propulsion Laboratory, Pasadena, California

An algorithm has been devised to reduce ground clutter in the data products of the CloudSat Cloud Profiling Radar (CPR), which is a nadir-looking radar instrument, in orbit around the Earth, that measures power backscattered by clouds as a function of distance from the instrument. Ground clutter contaminates the CPR data in the lowest 1 km of the atmospheric profile, heretofore making it impossible to use CPR data to satisfy the scientific interest in studying clouds and light rainfall at low altitude.

The algorithm is based partly on the fact that the CloudSat orbit is such that the geodetic altitude of the CPR varies continuously over a range of approximately 25 km. As the geodetic altitude changes, the radar timing parameters are changed at intervals defined by flight software in order to keep the troposphere inside a data-collection time window. However, within each interval, the surface of the Earth continuously "scans through" (that is, it moves across) a few range bins of the data time window. For each radar profile, only few samples [one for every range-bin increment ($\Delta r = 240$ m)] of the surface-clutter signature are available around the range bin in which the peak of surface return is observed, but samples in consecutive radar profiles are offset slightly (by amounts much less than Δr) with respect to each other according to the relative change in geodetic altitude. As a consequence, in a case in which the surface area under examination is homogenous (e.g., an ocean surface), a sequence of consecutive radar profiles of the surface in that area contains samples of the surface response with range resolution ($\Delta\rho$) much finer than the range-bin increment ($\Delta\rho \ll \Delta r$).

Once the high-resolution surface response has thus become available, the profile of surface clutter can be accurately estimated by use of a conventional maximum-correlation scheme: A translated and scaled version of the high-resolution surface response is fitted to the observed low-resolution profile. The translation and scaling factors that optimize the fit in a maximum-correlation sense represent (1) the true position of the surface relative to the sampled surface peak and (2) the magnitude of the surface backscatter.

The performance of this algorithm has been tested on CloudSat data acquired over an ocean surface. A preliminary analysis of the test data showed a surface-clutter-rejection ratio over flat surfaces of >10 dB and a reduction of the contaminated altitude over ocean from about 1 km to about 0.5 km (over the ocean). The algorithm has been embedded in CloudSat L1B processing as of Release 04 (July 2007), and the estimated flat surface clutter is removed in L2B-GEOPROF product from the observed profile of reflectivity (see CloudSat product documentation for details and performance at http://www.cloudsat.cira.colostate.edu/dataSpecs.php?prodid=1).

This work was done by Simone Tanelli, Kyung Pak, Stephen Durden, and Eastwood Im of Caltech for NASA's Jet Propulsion Laboratory.

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-44873.