



Lunar CRater Observation and Sensing Satellite

Q & A with John Marmie, Engineer & Deputy LCROSS Project Mgr
By Kathleen Richmond, AAE 12th grade

The Lunar CRater Observation and Sensing Satellite or LCROSS is a mission that hopes to find trace amounts of water at the poles of the moon. Finding any evidence of water is a tough task for NASA scientists, they have to develop specialized equipment that can not only find even the minutest trace of hydrogen and oxygen, but also navigate the LCROSS probe to a pole of the moon. The intended scenario is that the LCROSS probe will crash into the moon and create a dust cloud that will be analyzed for water. Even with such a daunting task, the scientists have prevailed as described by John Marmie, an Engineer and the Deputy LCROSS Project Manager.

Questions answered by John Marmie, Engineer and Deputy LCROSS Project Manager

There are multiple facets to LCROSS navigation...so to set the stage for my answers below, let me briefly describe the LCROSS navigation approach as compared to how the human body performs navigation in order to walk from here to the moon, for example: Start with the human brain. It holds information such as our position on Earth... as well as controls how we react in order to walk towards the moon. For LCROSS, this is analogous to the (Command and Data Handling Unit), or computer and electronics that gather information, then control how the spacecraft reacts as it navigates it's way to the moon.

Next, think of our eyes. Our eyes provide feedback to the brain as to where the moon is. For LCROSS, this is analogous to our Star Tracker. The star tracker is an optical device (same as our eyes) that translates the light reflected from stars into a position in space, and then provides that information to the computer. Our eyes also give us a sense of distance...or how much farther we have to walk in order to get to the moon. For LCROSS, this is analogous to our tracking stations on the ground. These large Deep Space Network antennas are able to determine how far away the spacecraft is...then people on the ground use this information to determine were to turn and how much farther the spacecraft has to go to get to the moon.

Next, think our inner ear...or the human body's mechanism for balancing. The inner ear contains three canals. In simple terms, the three canals contain a gel-like liquid and tiny hair cells. When both inner ears are working properly they give the brain information about linear and angular positions of the body with respect to gravity. For LCROSS, this is analogous to our Inertial Reference Unit or IRU. The IRU tracks angular movements of the Spacecraft and provides that feedback to the computer.

Next, think of our legs...or the human body's way to move toward the moon. For LCROSS, this is analogous to our thrusters. Our thrusters provide our spacecraft a means to adjust our position as well as move forward/backwards.

As the human body walks towards the moon...all these parts of the body (and more) continually update with each step taken. Eventually...we would make it to the moon, barring gravity and the ability to walk in space. =) Same goes for the LCROSS spacecraft. All the components work together as a system, continually getting feedback and refining its position and direction in space until it reaches the moon. By the way, doing all of this while moving at nearly twice the speed of a bullet!

Now, given this analogy...let me answer your questions.



GAVRT – Goldstone Apple Valley Radio Telescope Program
Copyright © 2009 by Lewis Center for Educational Research.

All rights reserved.

www.lewislearning.org





1. **What would you say is the most important piece of navigational equipment for the LCROSS mission?** As you now know...our navigation is performed by a system of equipment. If I were to give each piece an importance level...I'd have to ask myself, "If I lost this piece of equipment, could I still get to the moon". So, if we lost the star tracker...we have some crude abilities to work around not having this information. If we lost the IRU, we still have star tracker to help us. If we lost our thrusters, we'd miss the moon, if we lost our computer...we'd just float thru space, if we lost our ground station feedback...we'd never know where to go to next. Since a thruster or a computer aren't technically "a piece of navigation equipment", I'd then have to then say that the ground station feedback and tracking becomes our most important part of navigation equipment for the LCROSS mission.
2. **What is the most complex piece of equipment for the LCROSS mission?** That's a tough question.... as most all equipment used on the LCROSS mission is complex. Since I'd have to judge complexity on essentially the number of electrical/mechanical components...I would say that the computer card is the most complex. Sometimes we loose sight that there are billions of transistors inside the computer chip in our home computer. This coupled with all the other functions that the computer board does to essentially emulate the human brain...then I would say it's the most complex piece of equipment.
3. **Was the concept of the Shepherd Spacecraft inspired by previous missions? If so, which ones?** The LCROSS mission does have many similarities to the Deep Space Mission a few years back...but since I wasn't the one that thought of the mission concept, then I can't really say if LCROSS was inspired by the Deep Space Mission.
4. **How was the concept for the navigational equipment developed?** Stars! Just like the sailors used in the old days. If a sailor had a map of the stars, then he/she could get pointed in the right direction. The Star Tracker works off the same principle. It carries a star map in its memory...and is able to determine its position given what it's optics (or eyes) sees and then tries to overlay that on the star map.
5. **What, would you say, is the best part about the LCROSS mission in relation to navigation and spatial equipment?** The best part, or the most amazing part is that we are traveling twice the speed of a bullet while navigating through space! Let's see you try to control your car at those speeds. =)
6. **What is different about the navigational equipment for LCROSS than previous missions?** There isn't anything different as far as navigational equipment for LCROSS and other missions. Most all spacecraft have similar equipment.

Perhaps one of the most modern missions of its time, LCROSS, America's return to the moon, relies on tried and true traditions. Navigating by stars, just as sailors did on the rickety wooden ships, the cutting-edge Star Tracker equipment will navigate the LCROSS probe into the pole of the moon rather than to an old spice route. Though the equipment is important, one of the most crucial aspects of the mission is not in the stars, but right here on earth. As described by John Marmie, the ground station feedback keeps everything running smoothly and ensures that the probe will crash accurately. With past missions to look back on and new technology to help it guide it's way into history, the LCROSS mission is a break through and opens an even newer frontier for NASA as well as the world.

