Unsung Greatness
By
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This is a story of one man, a regular guy, who unlike most of us that have made many small contributions to the space program, has made a major contribution to planetary investigation through his creativeness and determination. Apparently there has been little recognition of this work by his company or co-workers.

Gerald Raylan Hollenbeck was born in Abilene, Kansas on 22 September, 1930. He was a quiet, almost shy, yet friendly person, who grew up in the small farming community of Hope, Kansas. Gerry earned dual degrees in Aeronautical Engineering and Engineering Physics from the University of Kansas in 1953. Thereafter, he was continually calculating things in his head for just about any topic that might arise. He married shortly after graduation, and entered the U. S. Navy. During his military service, he was assigned to the TALOS program at Sandia Labs. He retained his farm-boy appearance and behavior except when physics was involved -- then he became very exacting and emphatic.

In his early tenure at Glenn L. Martin Company, he was well versed in missile and satellite launch and orbital dynamics. He was involved with Titan I, NOVA, and nuclear rocket studies. He prepared parametric performance analyses of ballistic missiles for the Air Technical Intelligence Command and later conducted Titan II, III, and Transtage Orbital Analyses. This including Titan vehicles with Agena and Centaur upper stages. He also led mission design studies for many Earth satellites defining altitudes, coverage, sensor requirements, and all satellite orbital parameters.

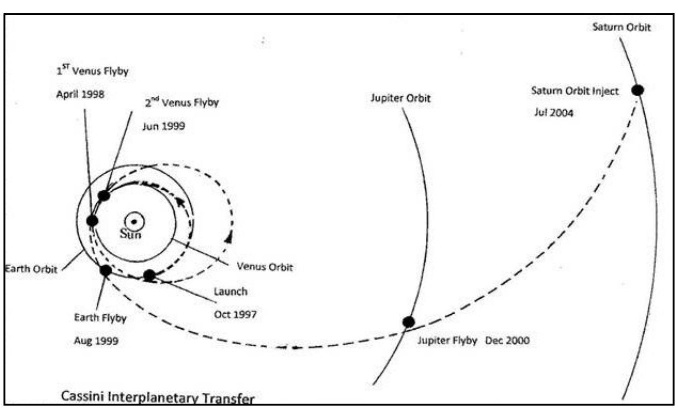
I first met Gerry when we were working together on an early Earth orbiting Phase B satellite study in about 1963. Later, I was lead engineer on several space system conceptual study programs and always looked to Gerry for our launch and orbital mission analysis work. He was never found to be in error and was recognized as a very reliable mission analyst by all concerned. Gerry and I became good friends and worked on many programs together.

Gerry did not use the company main frame computer; instead he relied on his programmable HP hand-held calculator. Later, when he had assistants, he outlined the analyses and had them run on the big machine. Gerry became interested in the methodology of gravity assist maneuvers for interplanetary transfer orbits to increase spacecraft velocity, and yield shorter transit times with less propellant for planetary exploration. One time, he was doing the mission analysis on a program I was on and he seemed extremely engrossed in his work. As it turned out he was studying and evaluating the use of gravity assist for various planetary missions. These flyby calculations are extremely complex and can stagger the imagination, yet he mastered them all.

In 1975, Gerry prepared and presented technical papers (see references) relating to the concept at aerospace technical conferences. His work attracted the attention of some people at the Jet Propulsion Lab and he established some contacts there. He had developed a plan to fly a mission to Saturn using a gravity assist planetary transfer since a direct mission to Saturn was not possible with existing boosters. When the Cassini mission was approved, JPL decided they would fly the interplanetary transfer exactly as he described it.

As we all know, his mission plan worked, making the mission possible by what seemed to be a "something for nothing" scheme. Of course, he knew there is no free lunch in physics. The significant velocity added to the comparatively small spacecraft derives from a miniscule, unmeasurable, loss of helical orbital velocity of the huge body (planet) being flown by, relative to the ratio of their masses. One way to think of this is that: if you are in a vehicle traveling at, say thirty miles per hour, and you can throw a ball forward at twenty miles per hour, the speed of the ball relative to the outside environment will be fifty miles per hour. Likewise, the speed of the vehicle will be reduced by an insignificant amount. This concept can also be reversed to slow a spacecraft, if needed, by arranging the flyby to approach the planet from the direction opposite to its orbital velocity. While this seems very simple, many parameters must be carefully designed and implemented accurately. The approach path must be carefully aligned with the velocity vector desired, and the flyby altitude is very critical. The closer to the planet the flyby occurs, the greater the gravity field, and a larger Spacecraft velocity increment can be achieved. Flybys of planets that have an atmosphere include an additional trade-off of flyby-altitude to avoid excessive atmospheric drag. In addition, risk of radiation damage is more acute as the flyby altitude is lowered for some flyby objects.

The concept of gravity assist trajectories was conceived by Yuri Kondratyuk 1919, and updated in 1925, using planets and moons as gravity assist bodies. This was really forward thinking, thirty some years before we even had a satellite in orbit around the Earth. Several earlier spacecraft have used simpler versions of gravity assist as early as the Luna 3 in 1959 by the USSR, the United States Mariner and Pioneer missions in 1974, and others. The Cassini mission was more complicated as it was designed to fly by (1) Venus, then (2) Venus again, then (3) Earth, and finally (4) Jupiter. The four-planet flyby was the most complicated mission profile yet, and each of the gravity assists contributed to the velocity required to reach Saturn. The long time between mission events increased mission risk, however the spacecraft performed flawlessly.



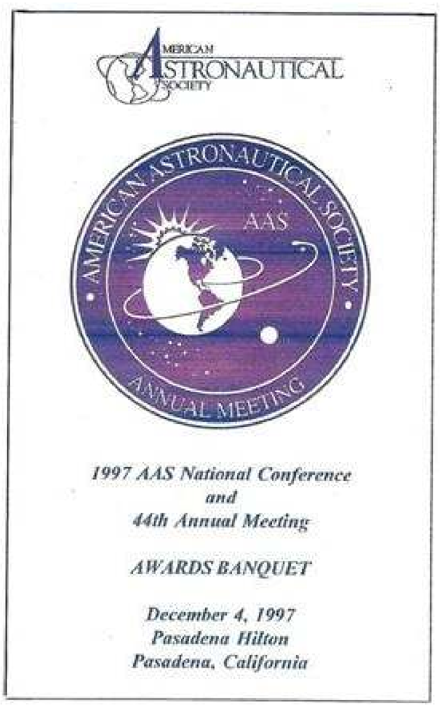
Cassini Interplanetary Transfer

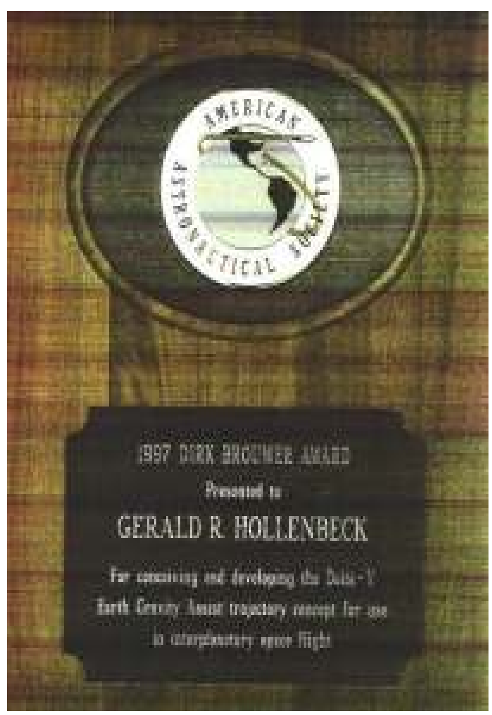
The Cassini mission was a major accomplishment in planetary science since the spacecraft carried an impressive instrument complex. Cassini also deployed a lander vehicle that successfully soft landed on the Saturn moon, Titan. Gravity assist flyby maneuvers were also used during the Saturn orbits to produce close approaches to some of the Saturn satellites, namely Titan, and Enceladus. The orbiting mission objectives included investigation of magnetic field properties, radiation, visual imaging, plasma waves, radar mapping, and planet ring composition, among others.

Mission accomplishments included much new, more detailed, data on Saturn, many high resolution surface photographs, a new understanding of the rings, and much improved knowledge of the moons, especially Titan and Enceladus, that included many surprises. None of this could have happened without Gerry's gravity assist interplanetary transfer.

As we recently witnessed the final Cassini Saturn orbit of the series in November 2016, it seems an appropriate time to relate this story. The spacecraft was launched back in 1997, its mission has been extended multiple times, and since it is essentially out of propellant, its useful lifetime is essentially over. To avoid the spacecraft becoming space junk, it has been redirected to an eccentric orbit that will have a periapsis close to the Saturn rings where it will gather more close-up data. If it survives the radiation and particle impacts until April 2017, it will then be placed into an orbit that will bring it below the main rings, where it can again gather data not available any other way. It is expected that atmospheric drag will then cause its orbit to slowly decay into the planet's atmosphere, and Cassini will enter and burn up in September 2017. A sad day for all those involved over its long lifetime and outstanding mission accomplishments.

In 1997, Gerry received a nomination from the Jet Propulsion Laboratory to receive the Dirk Brouwer Award for his work, to be presented at the 1997 American Astronautical Society Awards Banquet at JPL on December 4, 1997. The Dirk Brouwer Award is given annually "For Significant Contribution to Space Flight Mechanics and Astrodynamics." The list of previous awardees is quite impressive and anyone should be extremely proud to be recognized by it. I had the honor of accompanying Gerry at the presentation.





After retirement from Martin Marietta, Gerry spent his time in his home shop developing an apparatus to spread grit under the wheels of his car during snowy weather, and obtaining a patent for an improved carpenter's tool, along with other projects. We maintained our friendship and kept in contact every couple of months where we discussed our various home activities. He was hampered by failing health and sometimes experienced slight confusion. Gerry passed away 4 December, 2001. I believe that all those who knew Gerry will agree that he was an amazing person, and space scientist.

References

1. American Astronautical Society paper number AAS 75-087, July 1975, G. R. Hollenbeck, "New Flight Techniques for Outer Planet Missions".
2. American Astronautical Society paper number 75-279, August 1975, G. R. Hollenbeck, "Possibilities for Reducing High-Energy Performance Requirements".
3. American Institute of Aeronautics and Astronautics paper number 75-1138, September 1975, G. R. Hollenbeck, "New Options for Outer Planet Exploration".
4. Wikipedia.org Dirk Brouwer Award