

AIAA HOUSTON LUNCH AND LEARN

AUG 27
11:30AM - 1:00PM

Gilruth Center
1st Floor Discovery Room
18600 Space Center Blvd
Houston, TX 77058

Problems in ORBITAL MECHANICS

And Why We Have Them

Much of today's orbital-mechanics practices still traces back to centuries-old celestial-mechanics methods, applying iterative methods to converge on an orbital path to a mission destination.

Wes Kelly, Owner of Triton Systems, shows how with some re-arrangement "time of flight" calculations can address current problems such as selecting paths to Mars with simple trades by obtaining analytical solutions and their variants.

His company's study of Mars flights illustrates how "time of flight" to Mars can be adjusted, or traded, considerably with only slight changes in departure velocities from Earth. The methods applied grew from underrecognized advances made over the past few decades, enabling clear analytical solutions where mission planners previously might have had to rely on iterative numerical process obtained by more mysterious means.

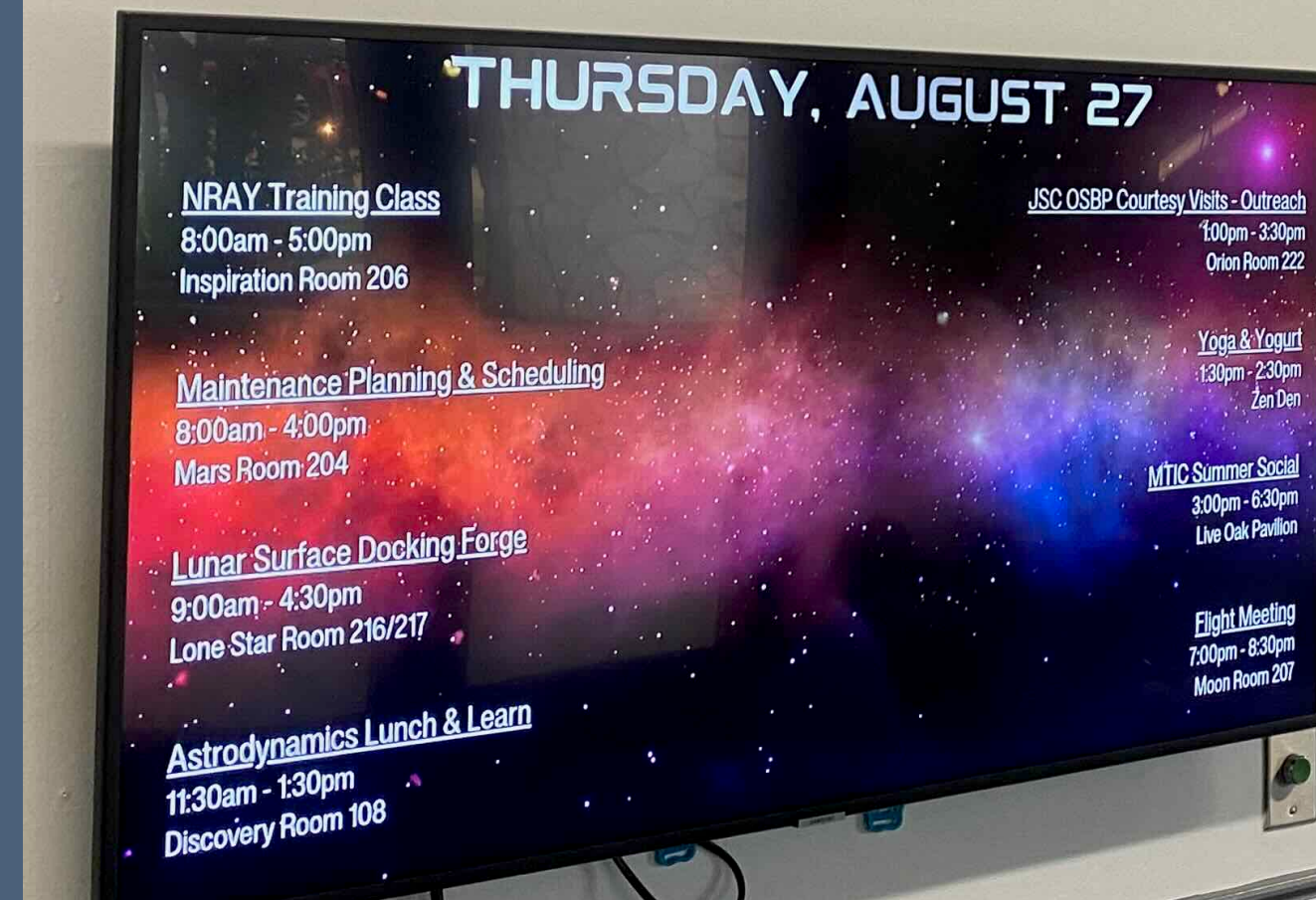


Presented by:
Wes Kelly
Owner, Triton Systems, LLC
Aerospace Consultants & Designs

Date: Thursday, August 27, 2026

Link to
YouTube
for a
Recording
of this
Event.

Gilruth Center Foyer



Flyer Design by Jake Peery of AIAA Houston

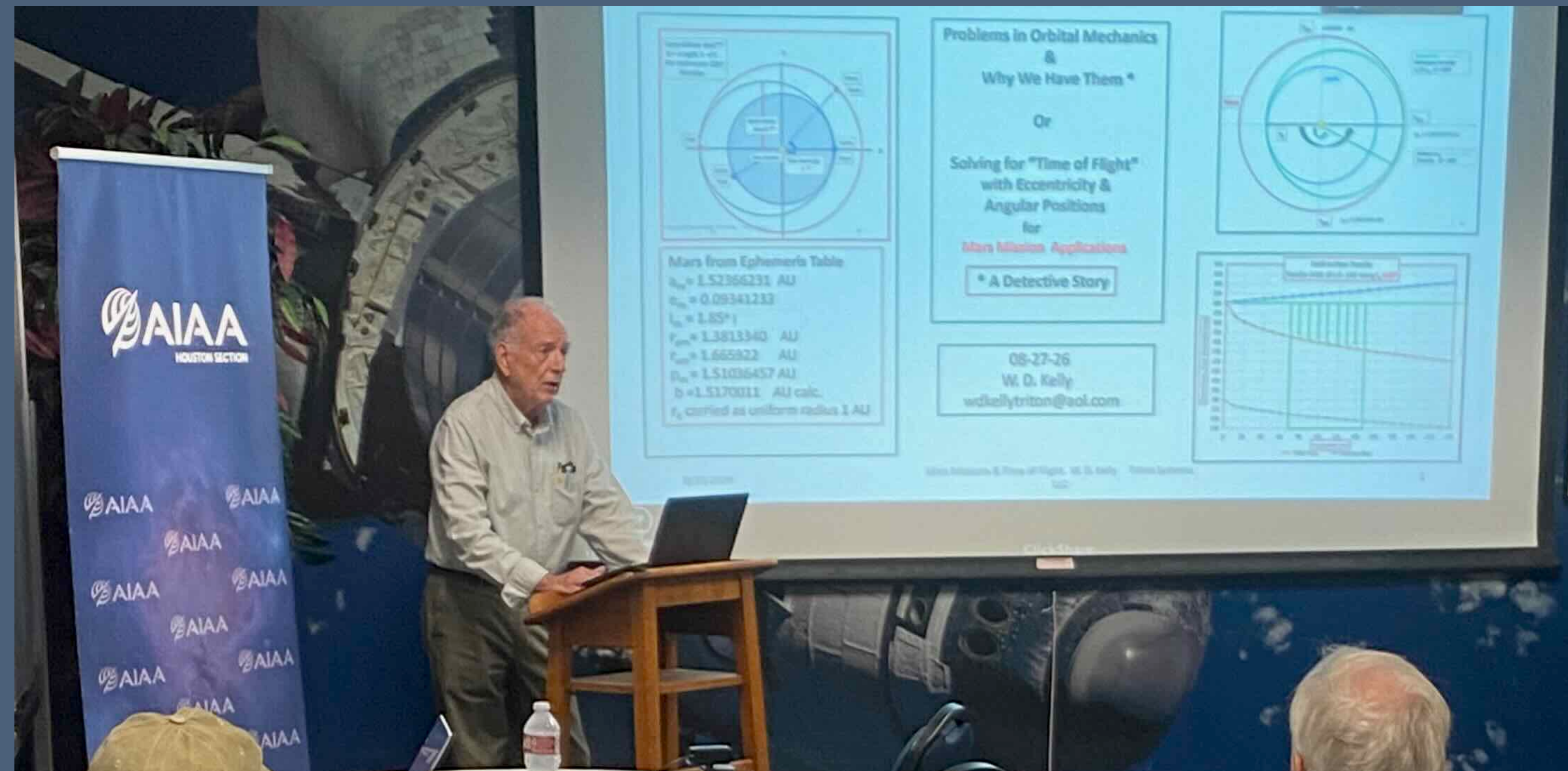
The American Institute of Aeronautics and Astronautics (AIAA)

Venue: NASA/JSC Gilruth Center Discovery Room

Photo Credits: AIAA Houston

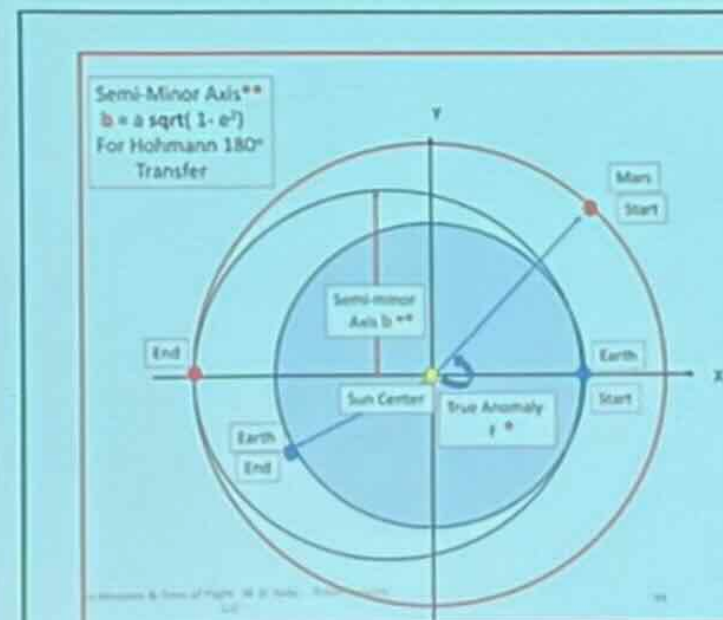
The AIAA Houston Astrodynamics Technical Committee Chair is Dr. Albert Allen Jackson IV.

Topic Introduced by Dr. Segun Thomas



Wes Kelly, Triton Systems LLC

Wes Kelly, Triton Systems LLC



Mars from Ephemeris Table
 $a_m = 1.52366231$ AU
 $e_m = 0.09341233$
 $i_m = 1.85^\circ$
 $r_{pm} = 1.3813340$ AU
 $r_{am} = 1.665922$ AU
 $p_m = 1.51036457$ AU
 $b = 1.5170011$ AU calc.
 r_E carried as uniform radius 1 AU

Problems in Orbital Mechanics
&
Why We Have Them *

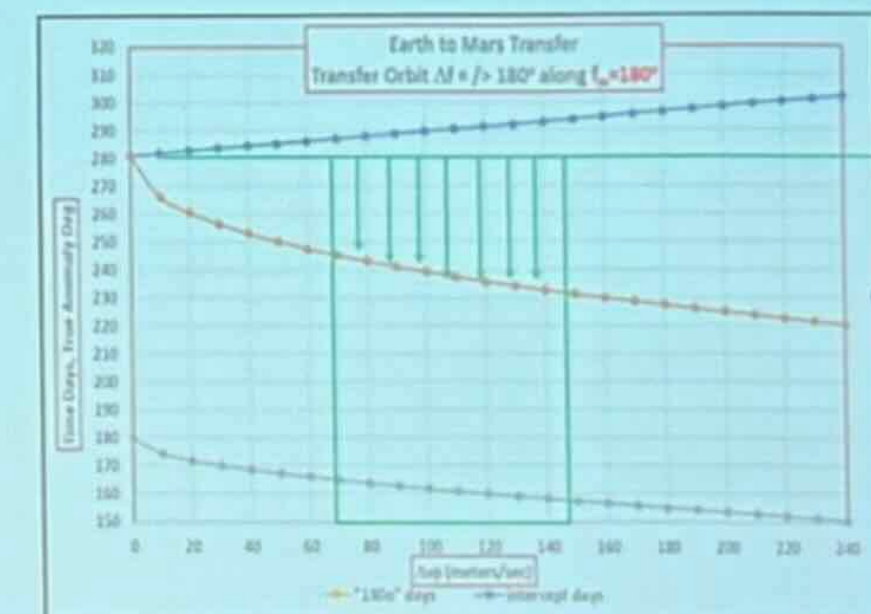
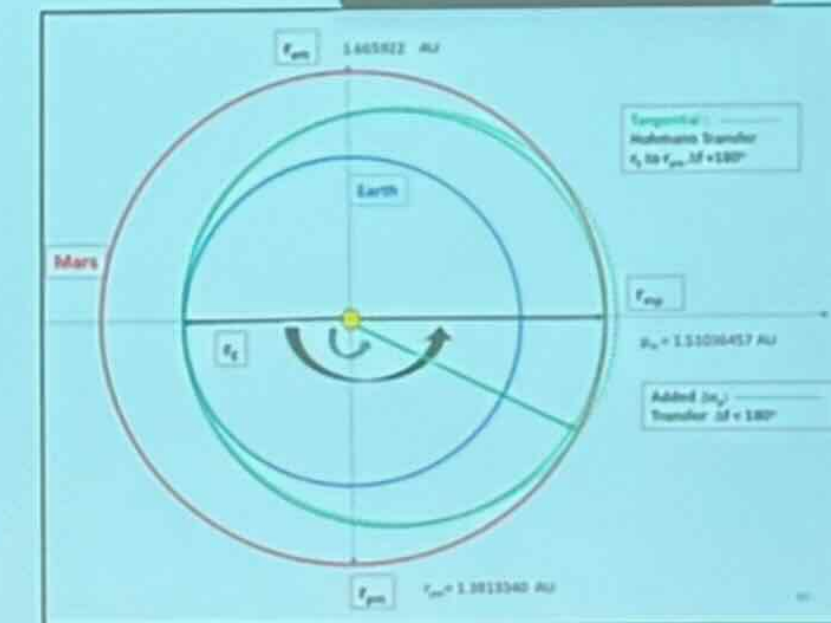
Or
Solving for "Time of Flight"
with Eccentricity &
Angular Positions
for
Mars Mission Applications

* A Detective Story

08-27-26

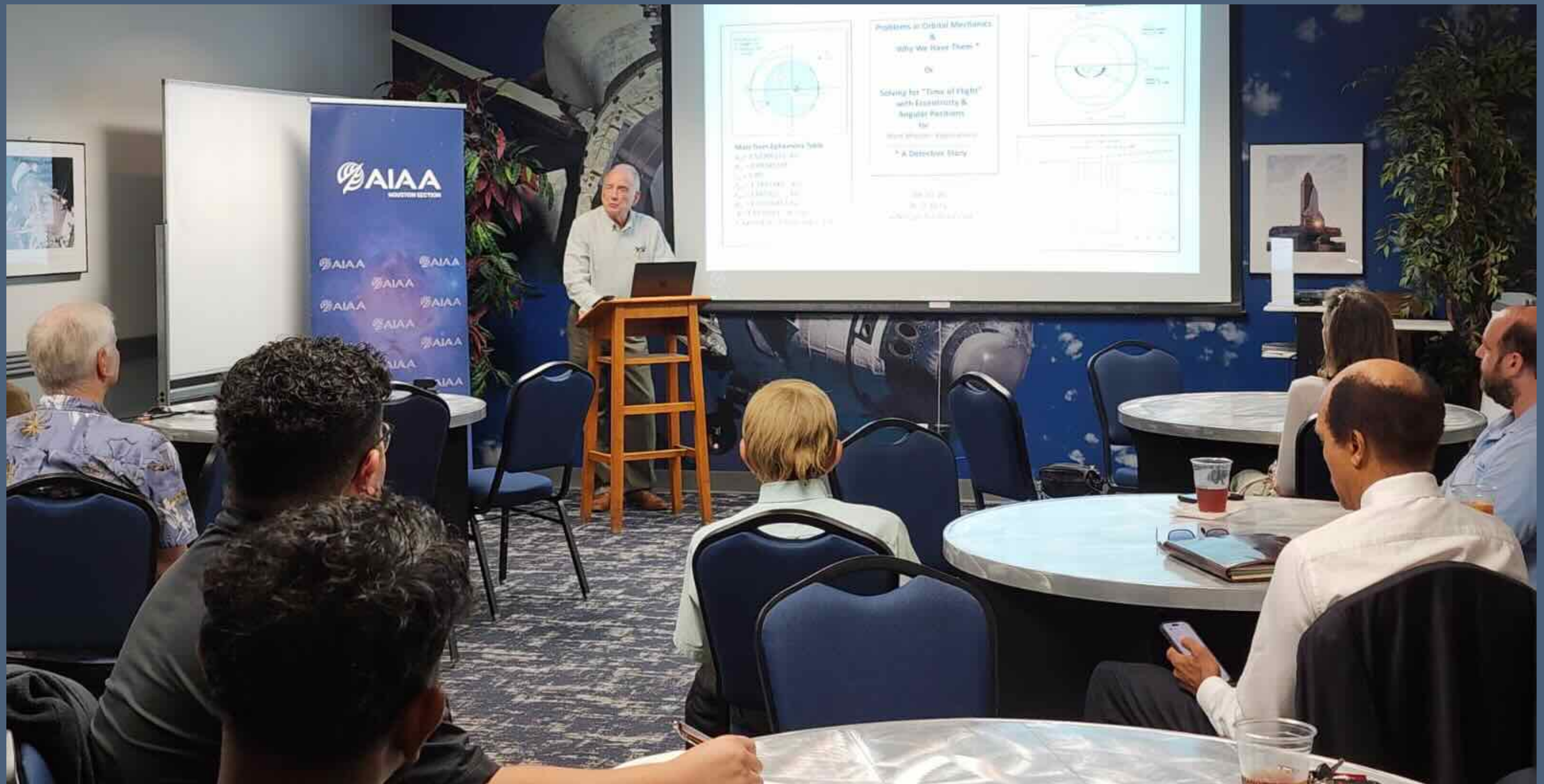
W. D. Kelly

wdkellytriton@aol.com



Mars Missions & Time of Flight W. D. Kelly Triton Systems LLC

Wes Kelly, Triton Systems LLC



Wes Kelly, Triton Systems LLC

The slide is titled "Mars Missions & Time of Flight" and is presented by W. D. Kelly, Triton Systems LLC. It contains several diagrams and equations related to exoplanet transit applications.

Top Left: A diagram showing a red planet transiting a yellow star.

Top Center: A graph titled "Transit to Transit" showing "Entry Velocity Ratios to Local Circular" for $e = 0.1, 0.2, 0.3, 0.4, 0.5$ and a "5 degree Window". The y-axis is "Velocity / Local Circular Velocity" ranging from 0.4 to 2.0. The x-axis represents time. The graph shows multiple curves for different eccentricities, with a shaded region indicating the "HZ of Red Dwarf M8 or M9".

Top Right: A diagram showing a red planet transiting a yellow star, with a red line indicating the transit path.

Center: A large yellow circle representing a star, with a small black dot representing a planet. A blue arrow points from the planet to the text "06-10-25 W. Kelly wdkellytriton@aol.com".

Center Right: A diagram titled "Earlier Development" showing a blue circle (planet) and a yellow circle (star) with a black dot (planet) inside. The diagram illustrates the geometry of the transit.

Bottom Left: A diagram showing a yellow star and a small black dot (planet) with a blue arrow pointing to the text "06-10-25 W. Kelly wdkellytriton@aol.com".

Bottom Center: A diagram showing a yellow star and a small black dot (planet) with a blue arrow pointing to the text "06-10-25 W. Kelly wdkellytriton@aol.com".

Bottom Right: A diagram showing a yellow star and a small black dot (planet) with a blue arrow pointing to the text "06-10-25 W. Kelly wdkellytriton@aol.com".

Equations and Text:

- Exoplanet-Star Geometric Relations:**
$$r_{ps}^2 = r_p^2 + r_s^2 - 2 r_p r_s \cos \theta^*$$
$$= r_s^2 \sin^2 \phi + [v(t - t_0)]^2$$
- Exoplanet Motion:**
$$y(t) = r_s \sin(\phi)$$
$$x(t) = -x_0 + v(t - t_0)$$

$v(t)$ also expressed as angular rate
 θ = planet angular position wrt stellar polar line
Rate can be varied as a function of orbit, if determined or desired.
- Equatorial Transition Area:**
$$A = \pi r_p^2 (2 \theta_p / 360^\circ) - r_p^2 \sin(\theta_p) \cos(\theta_p)$$
$$+ \pi r_s^2 (2 \theta_s / 360^\circ) - r_s^2 \sin(\theta_s) \cos(\theta_s)$$

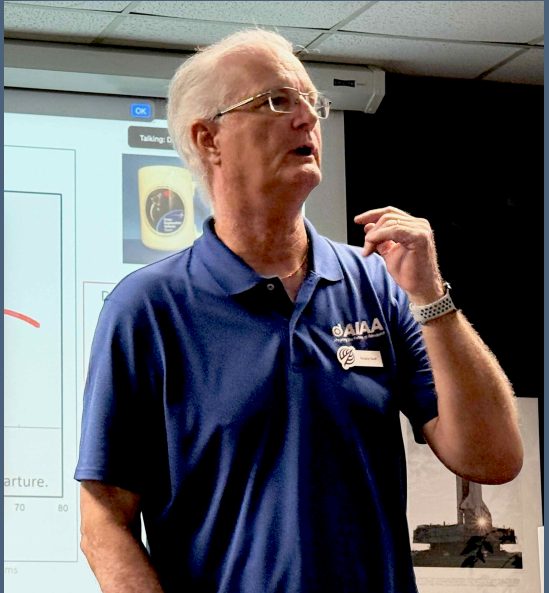
Footer: Mars Missions & Time of Flight W. D. Kelly LLC Triton Systems 46

Wes Kelly, Triton Systems LLC





Charlotte Newell is the new networking and socials lead at AIAA Houston. She worked for Collins Aerospace and Intuitive Machines. She is now working as a mechanical engineer for EON Innovations while finishing her Bachelor's Degree at Embry-Riddle.



Wes Kelly, Triton Systems LLC
Topic Introduced by Dr. Segun Thomas

Thanks to NASA/JSC Gilruth Center employees and all in AIAA Houston who helped with this event, especially AIAA Houston Chair John Rangel. Attendance was 17 people in the room and 21 people online. Dr. Svetlana Hanson hosted the online Zoom call & published the recording on YouTube.



Douglas Yazell, AIAA Houston Chair of the History & International Committees

Topic: Problems in Orbital Mechanics & Why We Have Them, by Wes Kelly of Triton Systems LLC

Date: Thursday, August 27, 2026

Time: 11:45 AM - 1:00 PM

Place: NASA/JSC Gilruth Center Discovery Room

Much of orbital mechanics application and instruction is based on celestial mechanics as practiced centuries ago, applying iterative methods to converge on an orbital path to a mission destination.

Yet with some re-arrangement, "time of flight" calculations address current problems such as selecting paths to Mars with simple trades by obtaining analytical solutions and their variants.

Our study of Mars flights showed how "time of flight" to Mars can be adjusted (or traded) considerably with only slight changes in departure velocities from Earth.

The methods applied grew out of developments over the last few decades not widely known, allowing analytical solutions where previously mission planners might rely on iterative numerical process obtained by more mysterious means.

The American Institute of Aeronautics and Astronautics (AIAA) started in 1963 by merging two other professional societies that existed since the early 1930s. AIAA has about 20,000 professional members and 15,000 university & high school members, as well as about 100 corporate members.

AIAA Houston has about 1200 members. Student chapters include University of Houston (UH) and Texas A&M University.

AIAA Houston also includes Mexico.

After Air Force service in Europe with a flying unit, Wes Kelly attended the University of Michigan and University of Washington (Seattle) obtaining Bachelor and Master degrees, respectively, in aerospace engineering, doing additional studies in astrophysics.

In the course of his engineering career he spent a significant portion in support of the development of human spaceflight (that is, the Space Shuttle here in Houston in the 1970s and the International Space Station - ISS - in the 1990s, plus a number of payload or launch systems work elsewhere).

As an entrepreneur, Wes and colleagues founded Triton Systems LLC, which developed a partially reusable launch system concept submitted to the ISS resupply competition and later addressed toward small satellite launch.

In recent years he has worked as an adjunct instructor at UHCL teaching astronomy and electives such as exoplanets and orbital mechanics, topics related to today's talk.