Warp Drives & Wormholes

Exploiting the Boundaries of Physics

Marc G. Millis & Eric W. Davis
Geometric Spacetime Shortcuts

Wormholes - 1988

Warp Drive - 1994

Progress

Conjecture
"I want to believe"

Speculation
Sci-Fi

Science
Nature

Technology
Devices

Commerce
Profitable Devices

Graphics from Discovery Magazine

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Brainstorming Faster-Than-Light

Multiple Notions

- Brute Fast (Breaking Special Relativity) [Like Cerenkov]
- Tachyonic Conversions
- Quantum Non-Locality
- Sound Break Analogy $10^5$
- Spacetime Shortcuts
- "Translocation"
- "Hyper-stuff"
- Hyperspace
- Wormholes
- Warp Drives

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Space Warp Research Paths

Faster-Than-Light via Spacetime Engineering

Traversable Wormholes

Connections

Wormholes

Universes

Locations

Times

Spherical

Cubic

Aspherical

Polyhedron

Prisms

Loops

Flat

Sharp Edge

Rounded Edge

Faster-Than-Light via Spacetime Engineering

Warp Drives

Connections

Throats

Temporal

Dynamic

Static

Temporal

Warp Drives

Connections

Traversable Wormholes

Universes

Locations

Times

Spherical

Cubic

Aspherical

Polyhedron

Prisms

Loops

Flat

Sharp Edge

Rounded Edge

Credit: Eric Davis

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# Space Drives Inquiries

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'X' indicates nonviable

There is NO "BEST" approach
Deciphering What to Investigate

Contrast Now to Wow

**Rigorous Foundations**

What are the unsolved questions?

**Goal-Driven Visions**

What are the critical issues and unknowns?

Their intersection reveals the “Important Problems”
BOOK: Frontiers of Propulsion Science

First scholarly book about
- Gravity control propulsion
- Faster-than-light travel
- Related energy conversion
- Managing such research

For scientists, engineers, and their managers

Extensive references

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Warp Drives & Wormholes
Exploiting the Boundaries of Physics

Marc G. Millis & Eric W. Davis

ABSTRACT:
Ideas about faster-than-light travel matured from science fiction into scientific discourse in 1988. Since then, more than one approach has been conceived, and these topics now appear as homework problems in graduate textbooks. Although it is still not known if such breakthroughs can be engineered, the subject has advanced to where investigations are underway. In contrast to general physics, where the mysteries of physics are pondered in the context of the fate of the universe, the utilitarian perspective of spaceflight adds another solution approach with the potential to transform the fate of humanity. Presently the theoretical foundations that allow faster-than-light motion are an outgrowth of Einstein's general relativity. In contrast to the light-speed limit 'within' spacetime, Einstein's foundations allow the manipulation of spacetime itself – where different limits apply. The concept of a warp drive involves moving a bubble of space time faster than light can move through spacetime, while the wormhole concepts involve creating shortcuts through spacetime. One of the focal questions is how to create sufficient 'exotic matter' (with negative energy) to induce the desired spacetime warping. Another question is if such concepts are ready for experimental test. Additionally, these pursuits draw attention to the very meaning of conservation of momentum, physics of the quantum vacuum, and the very definition of mass and inertia. This presentation will introduce a variety of options, critical issues, and next-step research questions. For more comprehensive coverage, refer to the book: Millis & Davis (eds) 'Frontiers of Propulsion Science,' AIAA 2009.