National Aeronautics and Space Administration

technology solution

Aeronautics

Re-entry Vehicle Shape for Enhanced Performance

Aero Assist Capsule Vehicle Geometry For Atmospheric Entry

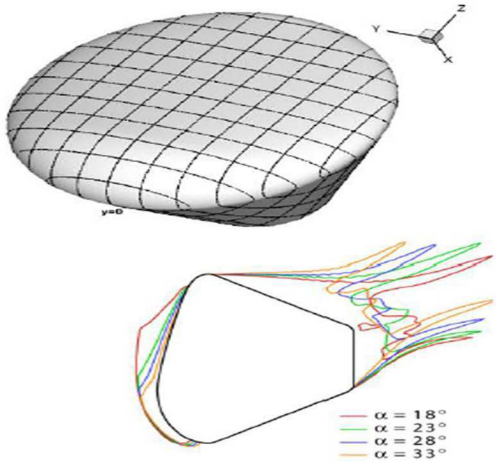
NASA has patented a new technology for enhanced aerodynamic performance and/or reduced heat transfer requirements for a space vehicle that re-enters an atmosphere. This unique innovation provides an improvement over prior blunt-body shapes. The new convex shell structure has a fore-body, an aft-body, a longitudinal axis and a transverse cross sectional shape, projected on a plane containing the longitudinal axis. It includes: first and second linear segments, smoothly joined at a first end of each of the first and second linear segments to an end of a third linear segment by respective first and second curvilinear segments. It also includes a fourth linear segment, joined to a second end of each of the first and second segments by curvilinear segments, including first and second ellipses having unequal ellipse parameters. The cross-sectional shape is non-symmetric about the longitudinal axis. The fourth linear segment can be replaced by a sum of one or more polynomials, trigonometric functions or other functions satisfying certain constraints.

BENEFITS

- Improves blunt body shapes
- Enhances aerodynamic and aerothermal performance
- Minimizes heating levels
- Allows a greater payload in same volume
- Simplifies design performance optimization

THE TECHNOLOGY

The new NASA space vehicle shape is actually of a class of geometric shapes that is describable by a relatively small number of geometry-shape parameters, easily generated automatically by computer, and that provides a broad range of geometric-shapes with favorable aerodynamic and aerothermal properties. These properties can then be rapidly and efficiently analyzed by computerized optimization methods for desired performance. Optimization of the vehicle geometry-shape parameters can, for example, minimize heating levels subject to constraints that reduce aerodynamic performance such as lift / drag, or can minimize weight of a thermal protection system, allowing a greater payload. Other properties can be optimized or established as constraints on a geometric parameter search, such as a requirement that a minimum lift/drag be met or exceeded, while minimizing center of gravity offset from vehicle centerline, to ease packing of a working vehicle while in space operations.



Enhanced Performance Reentry Blunt Body (Capsule)

APPLICATIONS

The technology has several potential applications:

- Aerospace Technology
- Systems Engineering
- Thermal Protection Systems
- Spaceflight

PUBLICATIONS

Patent No: 7,431,242

More Information

National Aeronautics and Space Administration

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