FREEFALL AEROSPACE

VLEO Satellite Communication System Design

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VLEO communication applications and benefits

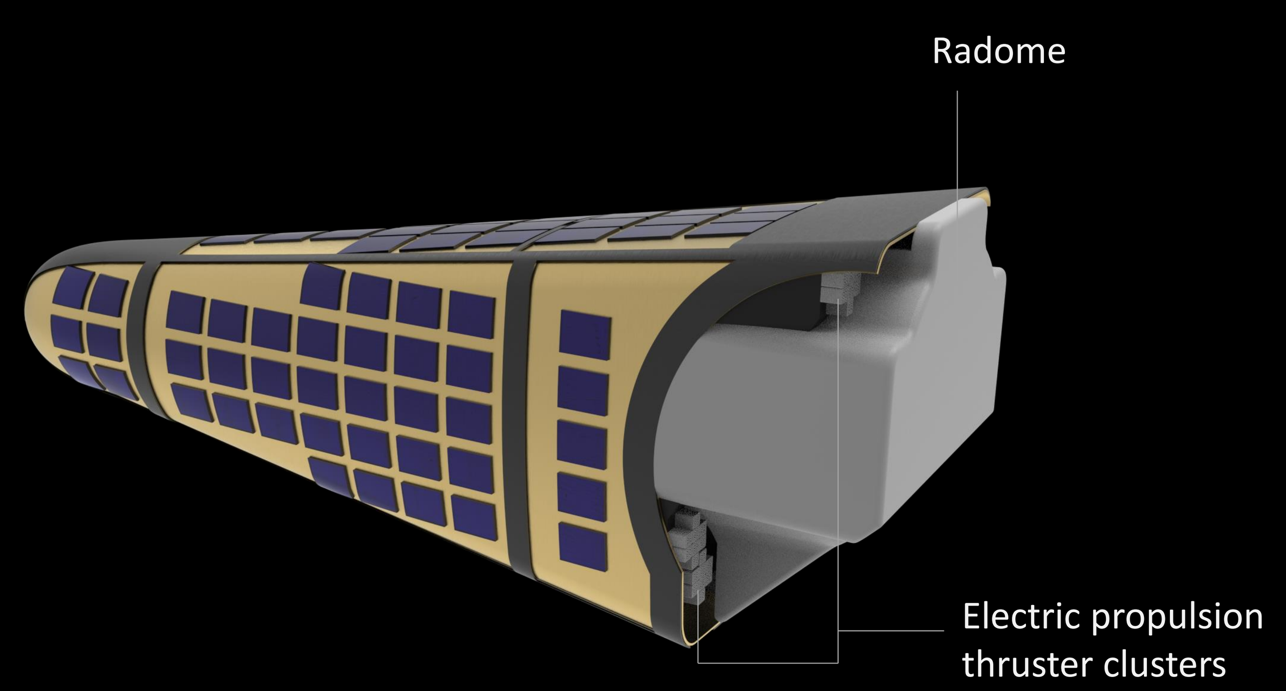
- Improved satellite internet access.
- Latency reduction for fixed services.
- High-speed satellite internet.
- Enables critical services requiring low latency: telemedicine, autonomous vehicle management etc.

VLEO communication system - major requirements

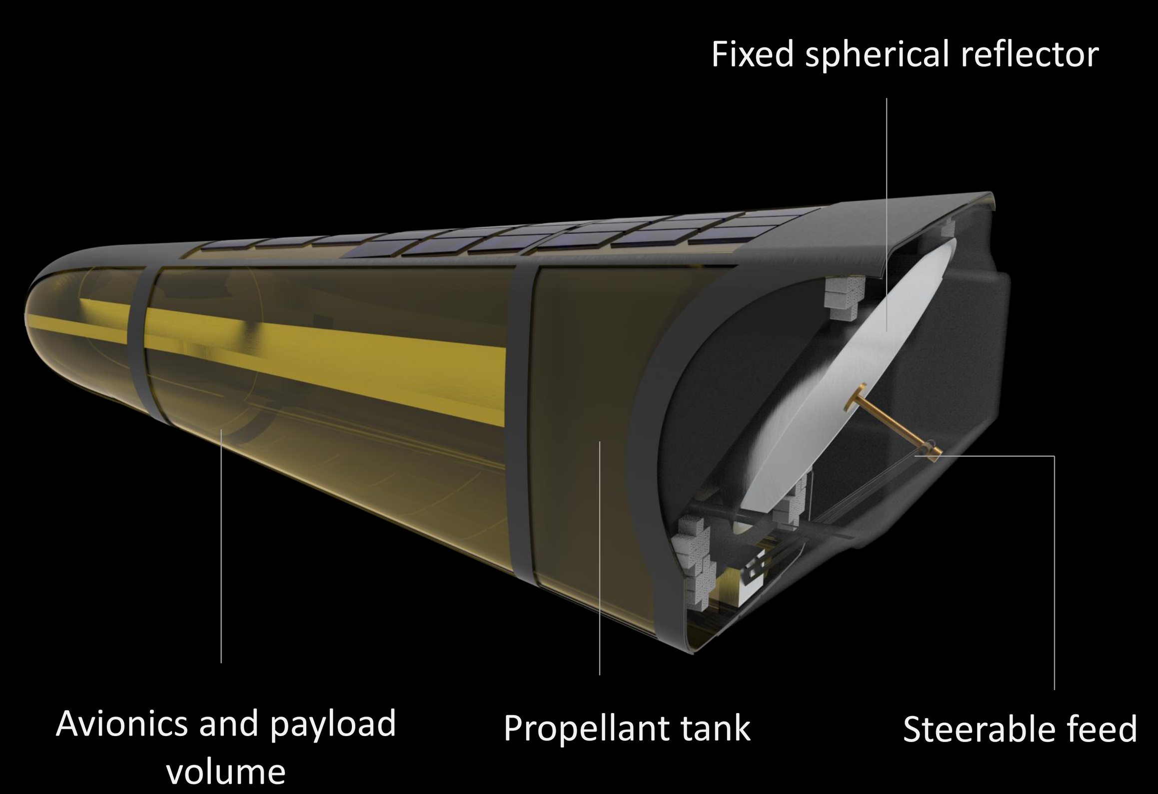
- Low-profile and/or aerodynamic shaping compatible.
- Steerable beams for adequate access to ground terminals.
- Low size, weight and power (SWAP).

Proposed system overview

- Conical geometries examined for drag reduction and solar panel surface area.
- A fixed spherical reflector system with a steerable feed system.
- Feed design architecture scalable over Ku, Ka and V-band.
- Steering range of +/60 degrees (AZ/EL) achievable.



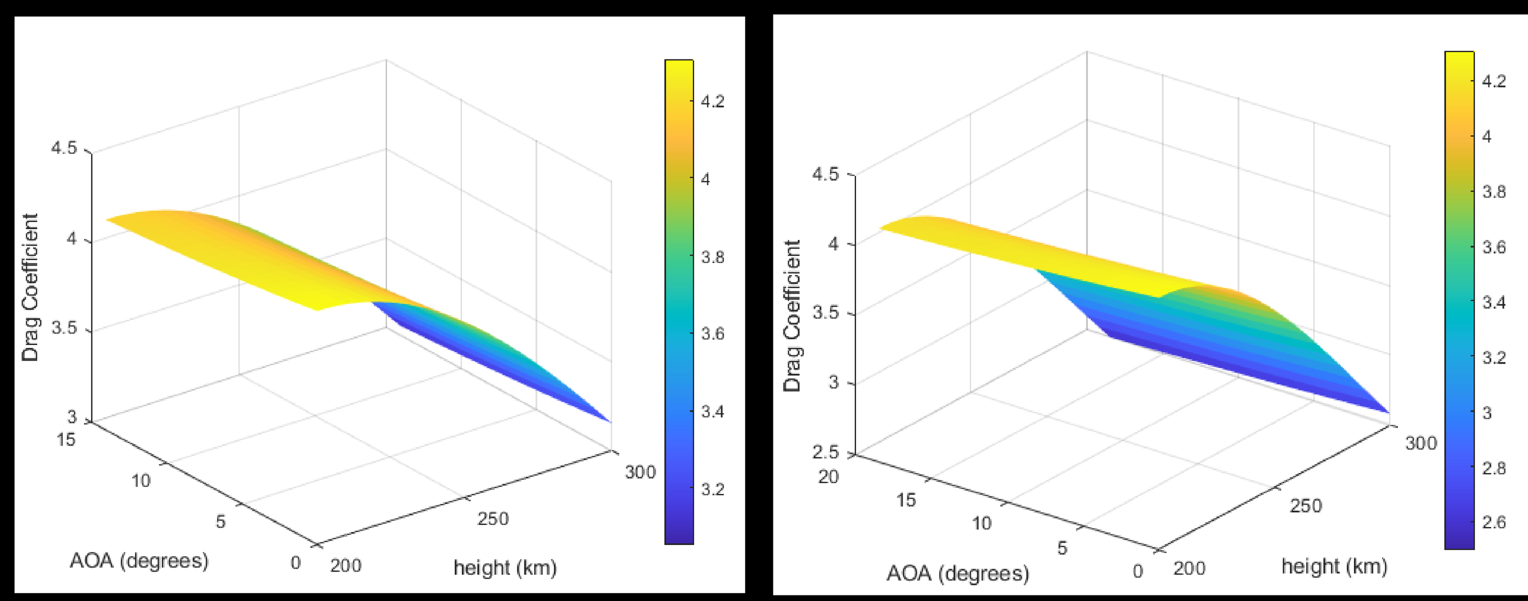
External configuration



Internal configuration

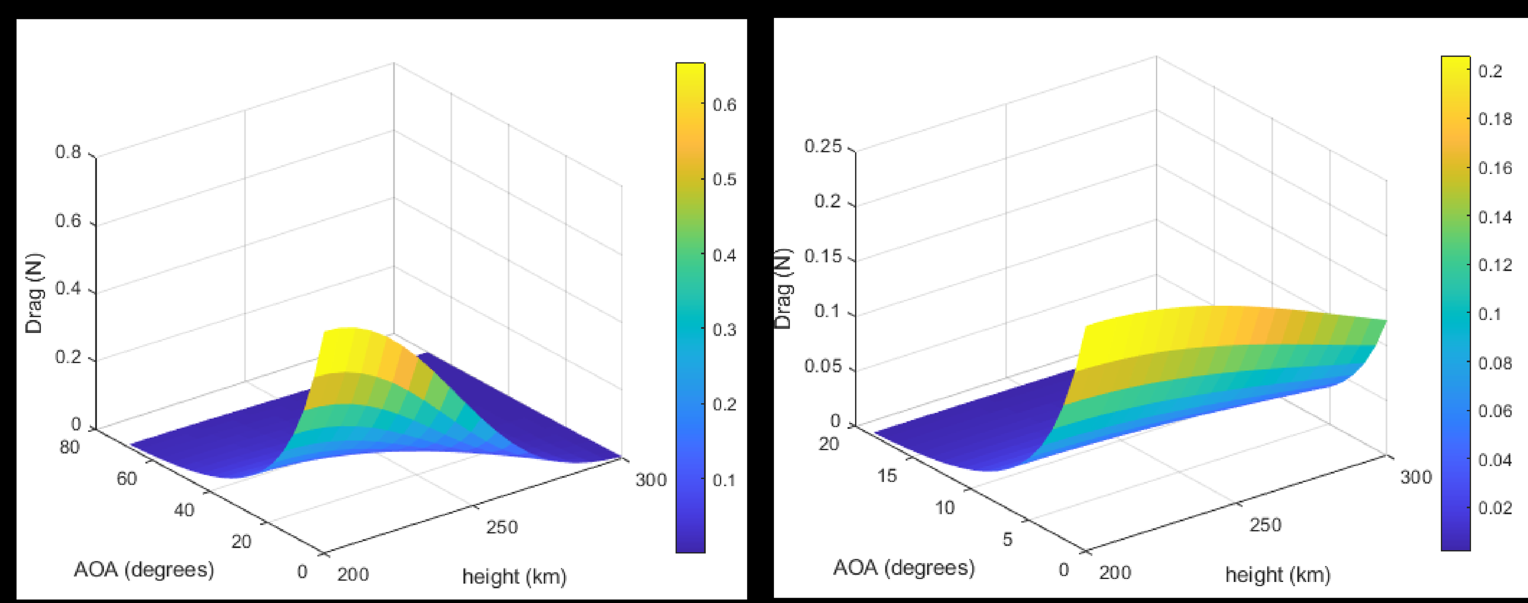
Satellite shaping and drag analysis

- Shape optimization model developed using free molecular flow theory.
- Drag estimated using Direct Solution Monte-Carlo simulations.



L=1 m, W = H = 0.5 m   L=0.6 m, W = 0.35 m, H = 0.3 m

Drag co-efficient as a function of angle of attack (AOA) and altitude

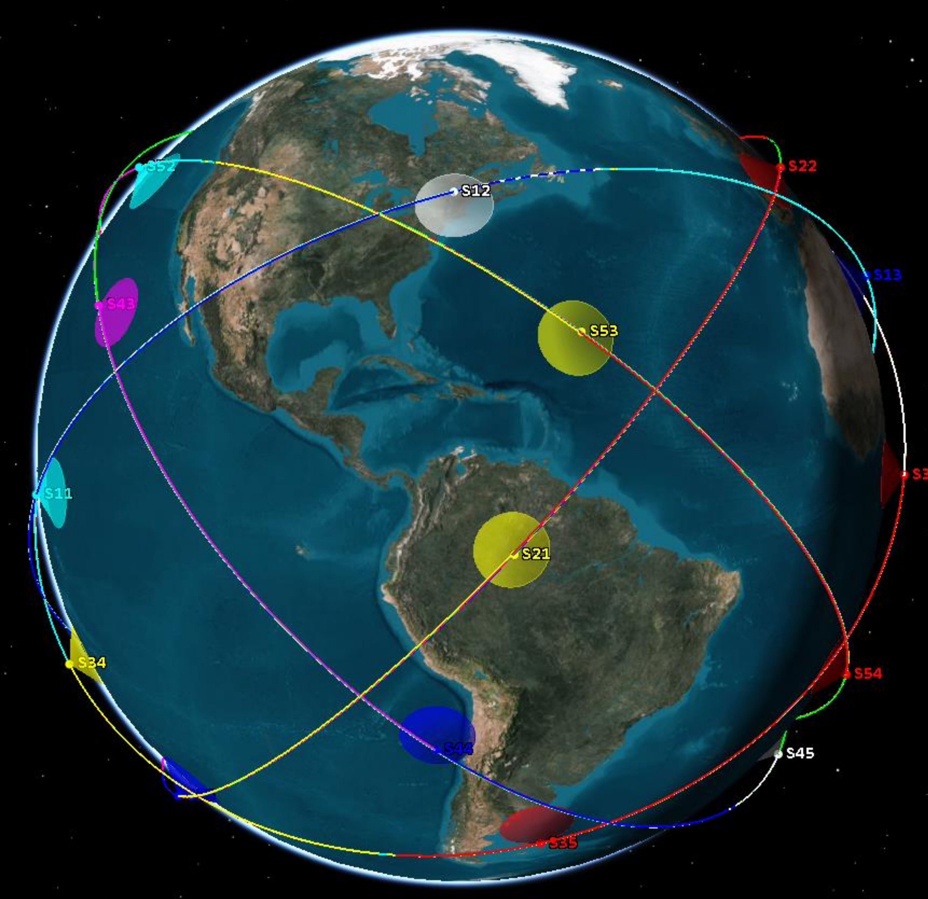


L=1 m, W = H = 0.5 m   L=0.6 m, W = 0.35 m, H = 0.3 m

Drag force as a function of angle of attack (AOA) and altitude

Communications constellation design

- Ballard Rosette constellations under study.
- A 25-satellite architecture distributed in 5 orbit planes at 270 km altitude baselined for coverage optimization.



25 Satellite Rosette architecture with expected beam angles

Conclusion and future work

- Preliminary design of a steerable reflector antenna system completed.
- A scalable architecture presented that supports Ku, Ka and V –band.
- Further shape optimization underway to minimize drag required.
- Feed design optimization to enhance steering range and illumination underway.

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