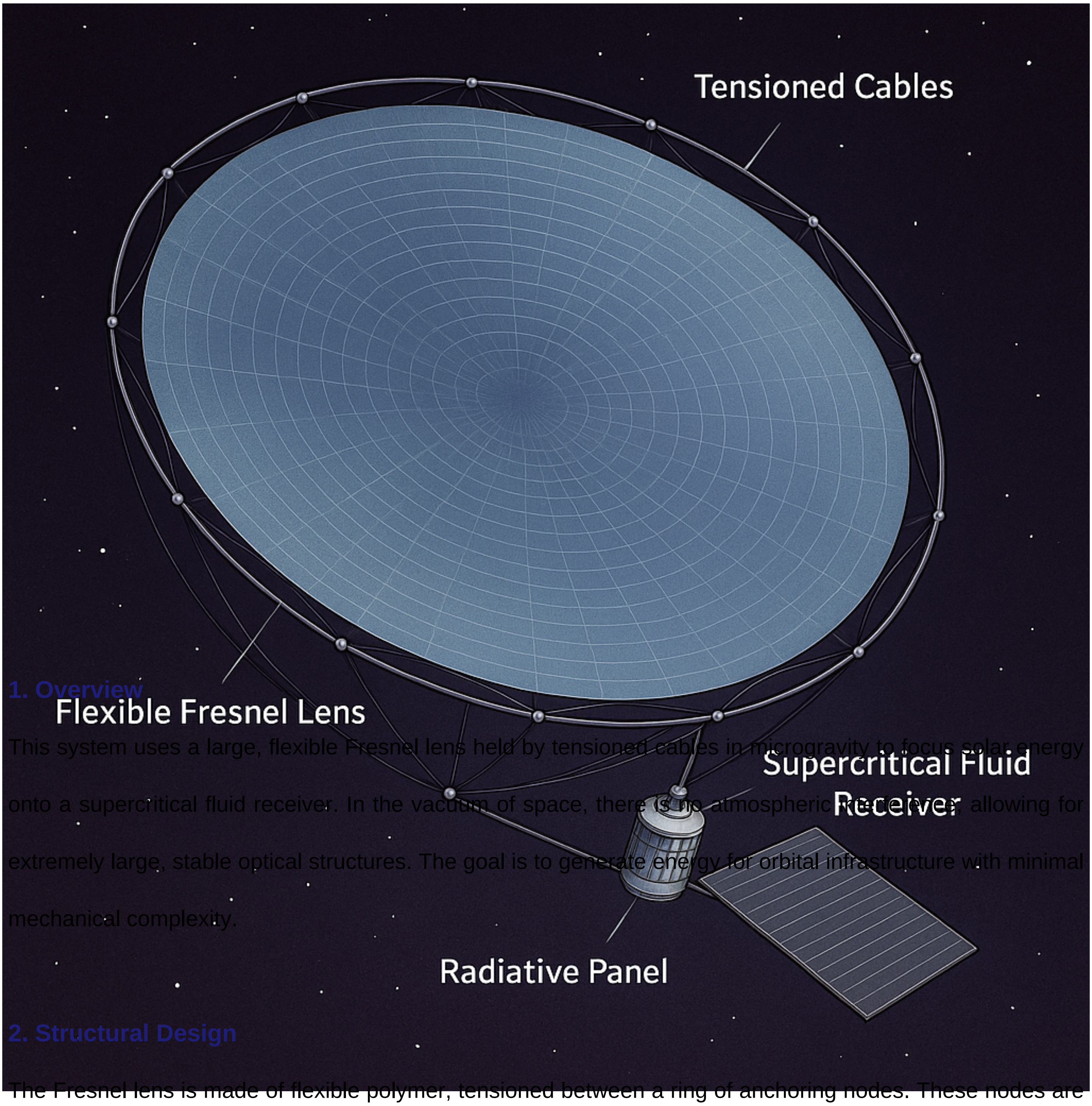
White Paper: Space-Based Supercritical Solar Concentrator



1. Overview

This system uses a large, flexible Fresnel lens held by tensioned cables in microgravity to focus solar energy onto a supercritical fluid receiver. In the vacuum of space, there is no atmospheric interference, allowing for extremely large, stable optical structures. The goal is to generate energy for orbital infrastructure with minimal mechanical complexity.

2. Structural Design

The Fresnel lens is made of flexible polymer, tensioned between a ring of anchoring nodes. These nodes are connected to a rigid frame that also supports the thermal receiver and radiative cooling panel. The entire system is stable, scalable, and resilient to micrometeoroid impact due to its flexibility and redundancy.

3. Thermal System Operation

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The supercritical fluid absorbs concentrated solar energy and drives a power conversion cycle. Instead of active pumps, the system uses pressure differential valves to cycle the fluid. As it cools via radiation panels, it naturally returns to a lower-pressure state, completing the loop with very little energy loss.

4. Advantages

- No atmospheric distortion: optical precision is maximized.

- No active compression: less mechanical wear.

- Passive cooling: efficient thermal control via radiation.

- Modular and flexible: scalable up to kilometer-scale lenses.

- Impact-resilient: tolerates micrometeoroid strikes without failure.

5. Applications

This system is ideal for powering space stations, asteroid mining hubs, orbital manufacturing platforms, and interplanetary energy relays. Its passive, resilient, and scalable design makes it a cornerstone of future space-based energy systems.