# Hipersfera d.o.o. – Hypersphere rigid airships

Peter Lobner, 11 February 2022

## 1. Introduction

The firm Hipersfera d.o.o. in Zagreb, Croatia has developed their proprietary unmanned airship technology into moored and free flying rigid airship configurations that offer clients “a robust industrial-grade payload capability,” primarily for remote sensing and telecommunications applications. The Hipersfera airships, known as “Hyperspheres,” are designed for slow flight or hovering, all-weather, long-endurance operations with mission specific payloads. These airships can operate individually or collaboratively as part of an airborne fleet tasked with providing real-time coverage for a large surface area.

The Hipersfera website is here: https://hipersfera.hr

*General arrangement of a rigid, geodesic Hypersphere.*
*Source: Hipersfera (2012)*

## 2. Basic design

Basic features of the Hypersphere airship include:

- Lightweight, rigid geodesic spheroid hull made of composite materials
- Electrically-driven vectored thrusters are installed around the equator of the spheroid hull
- Omnidirectional; able to fly in any direction instantly
- Modular mission-specific payload up to 100 kg (220 lb) is carried inside the hull, at the bottom of the spheroid
- Designed for real-time flight management in all-weather conditions
- Modest cruise speed (45 – 65 kph / 28 – 40 mph)
- Medium altitude (2 – 5 km / 6,500 – 16,400 ft) free flyer and, moored (tethered) version.
- Transponder enables operation within an air-traffic control zone
- Long endurance missions; 24 to 100 hours of continuous flight, depending on environmental conditions
- Long service life with regular maintenance; at least 15 years

## 3. The 1SM scale model

The first scale model (1SM) Hypersphere is a small , rigid craft with a diameter of about 3.6 m (11.9 ft) and a height of 1.9 m (6.3 ft). It is in the same size range as several other small, rigid airship demonstration models built and flown in the 1970s by Michael Walden (the LTAS XEM-1, XEM-2 and XEM-3) and in 1981 by Mario Sánchez-Roldan (the SPACIAL XEM-4).

Originally, the 1SM, named “Stribor,” was envisaged as an indoor flight test article only. In 2010, testing via remote control demonstrated stable flight characteristics and the effectiveness of the remote flight controls.

Subsequent outdoor flight testing of the 1SM was conducted successfully later in 2010. This included setting an unofficial FIA world altitude record for airship class B-01 (400 $m^3$ and less) after climbing to about 57 meters (187 ft).

*An indoor flight test of the 1SM scale model.*
*Source: Screenshot from Hipersfera video (Sep. 2010)*

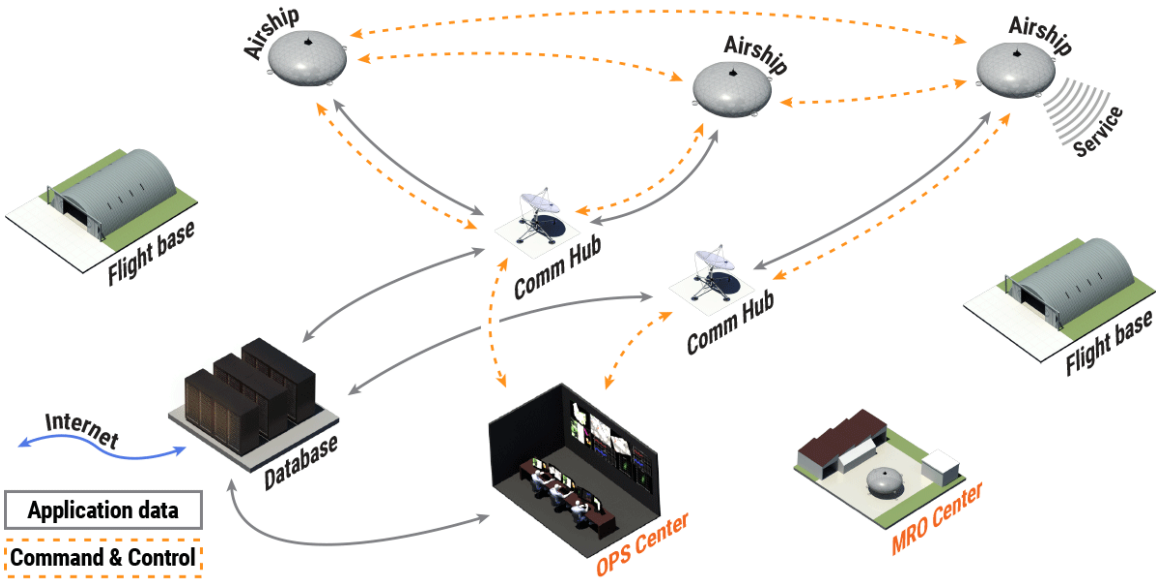
*An outdoor flight test of the 1SM.*
*Source: Screenshot from Hipersfera video (Nov. 2010)*

*1SM airship recovered on a landing ring after a test flight. Source: Screenshot from Hipersfera video (Nov. 2010)*

*Part of Hipersfer's team gathers below the buoyant gas cell for their TERA-class developmental prototype airship. Left front is the 1SM scale model. Source: Hipersfera*

## 4. The Hypersphere HS-5K system

The HS-5K system is Hipersfera's concept of operations for Hypersphere airships integrated with an Oracle Enterprise Management Center (OPS Center) that can coordinate airship tasking from single or multiple flight bases. Ground-based communications hubs and communications links between Hypersphere airships establish a resilient, encrypted operational command and control communications network. Each Hypersphere airship has a separate encrypted applications data link to a communications hub that forwards the data stream onward to a data center for processing and/or distribution to the OPS Center and/or end users anywhere in the world. The HS-5K system operators have complete control over the entire encrypted data chain. A single maintenance, repair and overhaul (MRO) center can support many Hypersphere airships.




*HS-5K system concept of operations. Source: Hipersfera*

Hipersfera describes their Hypersphere HS-5K system as follows:

> "The Hypersphere HS-5K aircraft is classified as an autonomous unmanned airship of Medium Altitude and Long

Endurance, with the abbreviated designation MALE UAV. It uses helium to maintain its altitude, while control of the attitude and position is carried out via electrically-driven vectored actuators. The HS-5K airship has a payload capacity of 100 kg, which is sufficient for a sophisticated set of surveillance devices.

An important feature is the increase of the aircraft's availability of at least 50%. In other words, an expected flight time of at least 4,400 hours per year. Such a high availability is the result of the modular airship design, lean fleet functions, as well as a wide range of operational altitudes – from 2 to 5 km above sea level. The cruise airspeed is 40 km/hr, while the maximum airspeed is 65 km/hr. Such speed and the significant range of operating altitudes enable operating of the airship throughout the whole year, in almost all weather conditions.

Modular design enables a shorter MRO cycle (service in-between two consecutive flights), uninterrupted availability of spare parts, and simple and efficient upgrading of individual subsystems. The HS-5K aircraft has a modern transponder MODE S/C, and can fly within the air-traffic control system (ATC) or individually. The flight plan is given by the ground operator before take-off, however, it may be changed during the flight due to unexpected situations in the field, such as monitoring a facility. The expected lifespan of the aircraft, with regular and proper maintenance, is at least fifteen years."

You'll find a short video describing the Hypersphere 5K system at the following link: https://vimeo.com/53855487

The HS-5K system can be implemented for a wide range of applications that can be further integrated with existing customer systems, including:

- **Broadband telecom services:** fixed or free-flying airborne network has the potential to outperform traditional terrestrial mobile broadband network architectures
- **Telcom + continuous remote sensing for disaster management:** rapid deployment of telcom capabilities for first-

responders and separate replacement telcom the general population, and remote sensing to improve situational awareness within the affected area

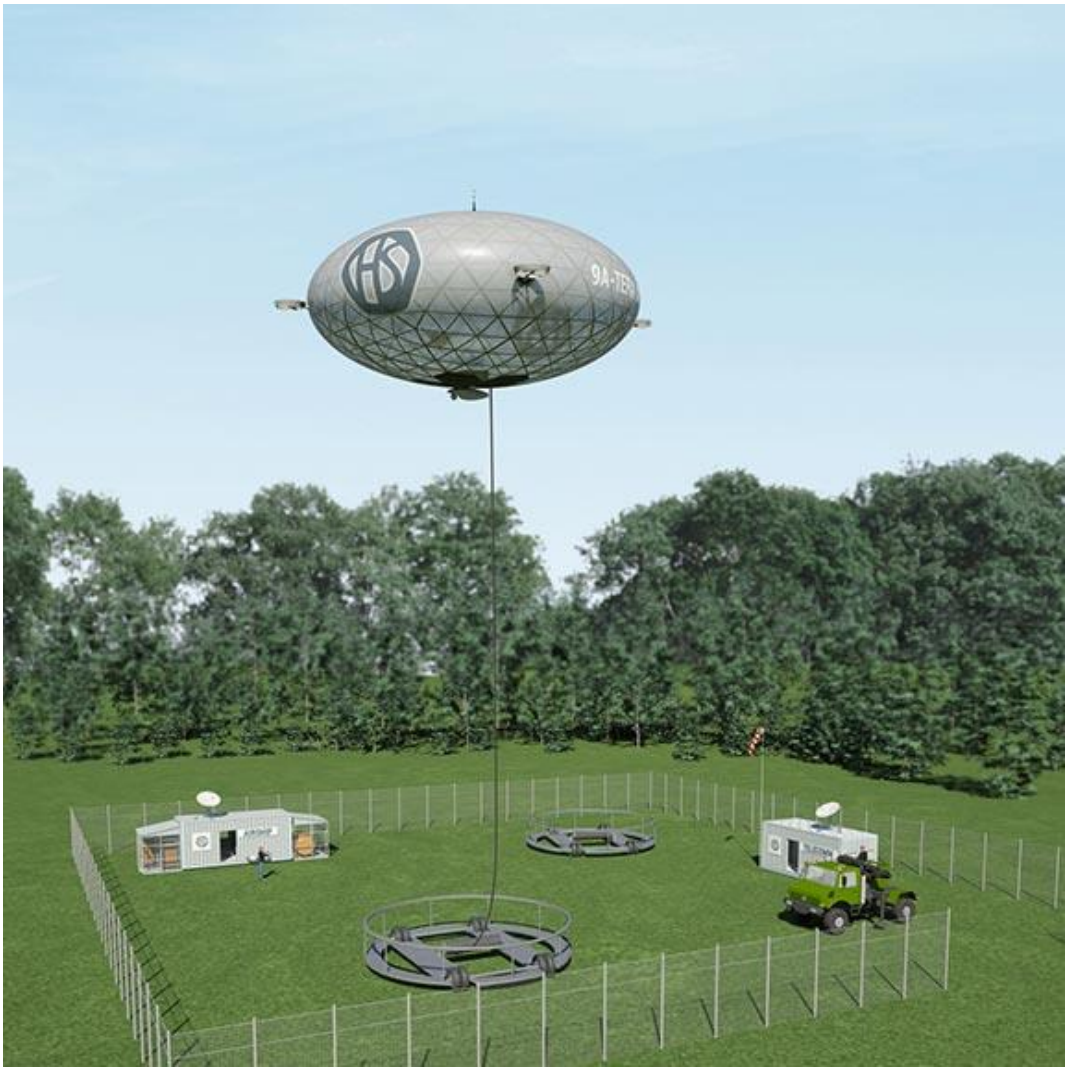
- **Telcom + continuous remote sensing for autonomous driving:** cost-effective deployment of high-speed data communications and sensing capabilities needed to support operation of autonomous vehicles (i.e., continuously updated road conditions & maps)
- **Continuous remote sensing for smart farming:** cost-effective, integrated, real-time agricultural data service
- **Continuous remote sensing for maritime and land border surveillance**: fixed or free-flying persistent border surveillance
- **Wide-area surveillance**: fixed or free-flying persistent surveillance that can be adapted to changing conditions

Equipped as a remote sensing system, Hipersfera claims that their HS-5K system and integrated concept of operations "can continuously monitor the Earth, over a particular geographical area, better than satellites and airplanes, both in price and performance."

*Rendering of a full-scale Hypersphere free-flying airship on a landing ring. Source: Hipersfera*

*Rendering of a full-scale, free-flying Hypersphere in low altitude flight.*
*Source: Screenshot from Hipersfera 5K video (2012)*

*Rendering of remote sensing equipment installed*
*on a Hypersphere flying at medium altitude.*
*Source: Screenshot from Hipersfera 5K video (2012)*



*Rendering of a full-scale tethered Hypersphere and ground facilities for handling two airships. Source: Hipersfera*

## 5. For more information

- "Hipersfera builds autonomous airship for border control and surveillance tasks," Smartlab, 20 November 2012: http://www.smartlab.at/hipersfera-builds-autonomous-airship-for-border-control-and-survaillance-tasks/
- "Hipersfera Ltd. - SME: Unmanned Aerial Vehicles and Remote Sensing," Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO), 2016: https://investcroatia.gov.hr/wp-content/uploads/2016/12/60-Hipersfera-Ltd.-ZAGREB.pdf

- Mark Thomas, “Croatia technology opens up the skies and brings an alternative to satellites,” The Dubrovnik Times, 19 May 2017: https://www.thedubrovniktimes.com/news/croatia/item/2432-croatia-technology-opens-up-the-skies-and-brings-an-alternative-to-satellites

## Videos

- YouTube video, “Hypersphere by KapitalNetwork,” (5:31 minutes, in Croatian, showing indoor flight testing), Hipersfera Project, 20 September 2010: https://www.youtube.com/watch?v=6_SGh76J87M
- Vimeo video. “Hypersphere 5K Overview,” (4:00 minutes), Bojan Pecnik, (Hipersfera Project Technical Director), 2012: https://vimeo.com/53855487
- YouTube video, “Hipersfera Overview,” (4:00 minutes), Hipersfera Project, 2016: https://www.youtube.com/watch?v=n9cK9EHHykI
- YouTube video, “Hypersphere 1SM Outdoor Flight” (3:00 minutes), Hipersfera Project, 10 November 2010: https://www.youtube.com/watch?v=P9Xjsn2wBH4
- YouTube video, “Hypersphere 2nd scale model airship flight simulation over Zadar area,” (2:30 minutes), Hipersfera Project, 7 September 2010: https://www.youtube.com/watch?v=LiH52VGiXkA

## Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
    - SPACIAL SA - lenticular airships
    - Walden Aerospace / LTAS - Lenticular, toroidal, variable buoyancy airships
- *Modern Airships - Part 2*: https://lynceans.org/all-posts/modern-airships-part-2/
- *Modern Airships - Part 3*: https://lynceans.org/all-posts/modern-airships-part-3/