Introduction to Lighter-Than-Air Systems
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### Lighter Than Air Systems
- Aerostatic lift + Dynamic Lift
- Highly fuel efficient
- Less complex operating mechanisms
- Slow
- More susceptible to weather changes

### Heavier than Air Systems
- No Aerostatic Lift
- Fuel inefficient
- Complex mechanisms
- Fast
- Less susceptible to weather changes
Airship
- Lift: LTA Gas
- Powered
- Directional Control

Aerostat
- Lift: LTA Gas
- Unpowered
- Only stabilizing surfaces

Hot Air Balloon
- Lift: Hot Air
- No Directional Control
- Balloon Direction depends on wind

Types of LTA vehicles
Hot Air Balloon = simplest form of LTA System!

Pix: Courtesy Wikipedia
Enclosed volume of Helium provides the aerostatic lift without any use of additional energy.

\[ L_B = V(\rho_a - \rho_g) \]
Components of an Airship

- Envelope
- Control Surfaces
- Gondola
Types of Airships

- **Rigid**
- **Non Rigid**
- **Semi Rigid**
- **Hot air**
Maiden Flight of Skyship 600

Source: http://www.youtube.com/watch?v=bwkJIU-zLJE
Modern Manned Airship

Adapted from: http://www.youtube.com/watch?v=U-OSvDfQuOU
USP of Airships

- Ability to operate from open fields
- Extremely high endurance capability
- Stationary / low-speed flight allows on-board surveillance systems to operate in high-clutter environment
- Large cabin space and low vibrations reduces crew fatigue
- Low noise, low environment pollution, unobtrusive vehicle
- Varied applications as an aerial platform
Existing Applications of Airships

- Advertisement & Product Promotion
- Aerial Observation & Surveillance
- Tourism and Corporate Hospitality
- Landmine Counter Measures
- Law Enforcement
Advertisement & Product Promotion

AE-664 Lighter-Than-Air Systems
Aerial Observation
Tourism
Sports Tracking
from A60+ operated by Metlife
Corporate Hospitality
MINESEEKER in KOSAVO
Police Surveillance

2004 Olympics, Athens

1996 Olympics, Atlanta

Time Lapse Video
Olympics 2012
APPLICATION OF AIRSHIPS ARE LIMITED BY ONES IMAGINATION
Tethered Aerostat Systems
Aerostat: Introduction

- Aerodynamically shaped tethered LTA platform
- Payload: communication and surveillance equipment
- Desired Features:
  - Higher payload capacity
  - Ability to maintain specified altitude
  - Stability in ambient wind conditions
- Envelope shape affects all these

Source: http://www.wsgi.com/

- $W_{\text{pay}}$: 10 – 15 lb
- $H$: 700 – 2000 ft
- $W$: 500 – 750 lb
- $L$: 20 – 30 ft
- $E$: < 48 hours
- $V$: < 45 kt
- $N_{\text{crew}}$: 1
- **Envelope (He chamber)**
  - LTA Lifting gas
- **Air ballonet**
  - Pressure and Buoyancy control
- **Tail fins**
  - Static and Dynamic stability
- **Tether**
  - Attachment to the ground
- **Payload**
  - Radar, camera, transponders, ..
- **Ground station**
  - Winching
  - Mooring
Moored Aerostat
Why Aerostats ??
## Aerostat v/s Aircraft

<table>
<thead>
<tr>
<th>Aerostat</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs good weather</td>
<td>Can work in bad weather</td>
</tr>
<tr>
<td>Remains Stationary</td>
<td>Can achieve high speeds</td>
</tr>
<tr>
<td>Zero fuel consumption</td>
<td>Massive fuel Consumption</td>
</tr>
<tr>
<td>Max. Endurance ~30 days</td>
<td>Max. Endurance ~16 hours</td>
</tr>
<tr>
<td>Can be launched from any terrain</td>
<td>Requires specific terrain to be launched</td>
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Aerostat v/s Satellite

- Aerostats are highly cost effective
- Aerostats are portable and can be re-located
- Aerostats provide greater detail as they are closer to the surveillance area
Various Applications of aerostats

- Surveillance & Communication
  - Border, Wide Area Land & Event Coverage
  - Sea-Based Deployment, Military Intelligence
  - Wireless, Long Range, High Speed, Last mile

- Local aerial surveillance

- Aerodrome protection
  - Balloon Barrage System
  - Communications platform during emergencies
  - Airborne Early Warning Radar System
Raytheon JLENS Aerostat

- Joint
- Land Attack Cruise Missile Defense
- Elevated
- Netted
- Sensor system
Other Examples of aerostat

- Used by meteorological department

Source: British Meteorology Centre
World’s Largest Aerostat
Used during Commonwealth Games 2010, New Delhi

40m X 80m X 12m
Blimp in a Box
Oblate Spheroid with Sail

Picture: Courtesy ALTAVE, Sao Jose dos Campos, Brazil, www.altave.com.br
Rapid Elevated Aerostat Platform
HISTORICAL PERSPECTIVES

Topic of the next lecture on 14th January 2014