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Tropospheric solar energy pseudo-satellites and their tasks

Tropospheric solar-powered pseudo satellites that provide long-term services in telecommunications, environmental monitoring, and scientific research. Their cost-effectiveness and advantages over traditional satellites

A tropospheric solar-powered pseudo-satellite is a high-altitude platform that flies in the troposphere at an altitude of 10-20 km (above commercial air traffic but below satellites) and functions like a satellite but remains within the Earth's atmosphere. These UAVs provide continuous, long-term services over a fixed area, using solar energy for long-duration flight, allowing for long-term operations lasting days, weeks, or months. They are sometimes called high-altitude pseudo-satellites (HAPS) or solar high-altitude pseudo-satellites (SHAPS) and are used for a variety of tasks, such as telecommunications, Earth observation, environmental monitoring, and more.

Such UAV-based solar energy pseudo-satellites are an innovative and cost-effective solution for tasks traditionally performed by satellites. They provide constant coverage, high altitude operation and flexibility for a wide range of missions while overcoming many of the limitations of traditional satellite systems. However, several issues such as energy storage, load capacity and regulatory issues need to be addressed for wider implementation and greater efficiency. Research in these areas is extremely promising, given the need to solve accumulated problems in various fields.

Considering the specific features and capabilities of tropospheric pseudo-satellites on the UAV platform, it is possible to formulate the specifics of the tasks they solve in the interests of various industries. The most common among them are the following tasks, which are presented in Fig. 1.

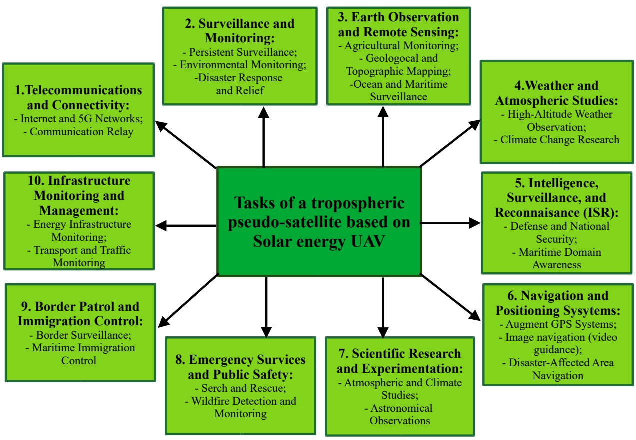

Fig. 1. Key tasks of tropospheric solar energy pseudo-satellites on the UAV platform.

1. **Telecommunications and communication.**
   a. Internet and 5G networks: Solar-powered UAVs can serve as aerial communication platforms, providing Internet access and 5G network coverage in remote or underserved areas. This is especially important in regions without developed infrastructure, such as rural areas, islands or areas affected by natural disasters.
   b. Communication Relay: HAPS can act as relay stations, connecting users or devices in remote locations to existing communication networks. This is particularly useful for mobile communications, radio communications and emergency response.

2. **Observation and monitoring**
   a. Continuous monitoring: Tropospheric pseudo satellites can provide continuous monitoring of large areas for long periods of time. This makes them ideal for military and defense applications such as border protection, detection of unauthorized movements and monitoring of sensitive areas.
   b. Environmental Monitoring: These UAVs can collect data on the state of the environment in real time, including weather conditions, air quality and indicators of climate change. This is useful for tracking pollution, monitoring deforestation and studying natural ecosystems.
   c. Disaster response and relief: In the event of natural disasters such as earthquakes, floods or wildfires, pseudo-satellites can provide real-time situational awareness. They can monitor disaster areas, assess damage, and help coordinate rescue operations by serving as communications hubs.

3. **Earth observation and remote sensing**
   a. Agricultural monitoring: Solar-powered UAVs can perform detailed agricultural surveys, providing data on crop condition, soil condition, and water use. This enables precision farming, helping farmers optimize the use of resources and increase yields.
   b. Geological and topographic mapping: Pseudo-satellites can acquire high-resolution images of the Earth's surface for topographic mapping, infrastructure monitoring, or surveying of resource-rich areas (such as mining and energy industries).
   c. Ocean and Sea Surveillance: These UAVs can monitor large ocean regions, tracking illegal activities such as piracy, smuggling, human trafficking, etc.

4. **Weather and atmospheric research**
   a. High-altitude meteorological observations: Solar-powered UAVs can continuously monitor weather conditions by collecting data on temperature, humidity, wind speed and other meteorological factors. This can improve weather forecasting and provide critical information for early warning systems (eg hurricanes, typhoons).
   b. Climate Change Research: Long-term atmospheric monitoring helps researchers study the effects of climate change, such as changes in atmospheric composition, cloud formation, and solar radiation. UAVs can provide

continuous data that would be difficult to collect using ground-based sensors or satellites.

5. **Intelligence, Surveillance and Reconnaissance (ISR)**
   a. Defense and National Security: For military purposes, HAPS can provide reconnaissance capabilities over specific areas of interest. They can monitor the movement of troops, identify threats, and monitor enemy activity. Due to their high endurance and ability to remain undetected at high altitudes, these UAVs are ideal for covert missions.
   b. Maritime intelligence: By continuously monitoring the ocean, UAVs can help governments and defense agencies maintain maritime awareness by tracking suspicious vessels or detecting illegal activity.

6. **Navigation and positioning systems**
   a. Advanced GPS systems: Pseudo satellites can improve Global Positioning System (GPS) coverage by providing additional signals, especially in regions where GPS accuracy is limited by obstructions (eg, dense urban areas, mountainous terrain).
   b. Image navigation (guidance video).
   c. Navigation in disaster-affected areas: After a disaster, when ground-based infrastructure such as GPS or cell towers are damaged, solar UAVs can temporarily restore positioning services for first responders and rescuers.

7. **Scientific research and experiments**
   a. Atmospheric and climate research: Scientists can use solar-powered UAVs to make long-term observations of the atmosphere, collecting data on greenhouse gases, aerosols and other climate indicators that are critical to understanding global warming.
   b. Astronomical observations: Solar UAVs flying at high altitudes can act as astronomical observation platforms, potentially providing data in certain atmospheric windows that cannot be obtained by satellites or ground-based observatories.

8. **Emergency services and public safety**
   a. Search and rescue: In large-scale search and rescue operations (such as after natural disasters or in remote wilderness areas), solar UAVs can help by providing high-resolution images, tracking the location of missing persons, or providing communication between rescue teams.
   b. Forest fire detection and monitoring: Solar UAVs can provide real-time data on the development of forest fires by detecting new fire outbreaks and tracking their progress. This information helps authorities coordinate firefighting efforts more effectively.

9. **Border and immigration control.**
   a. Border surveillance: High-altitude pseudo-satellites can continuously monitor borders for illegal crossings, human trafficking, or other illegal activities. They

offer a cost-effective and less intrusive alternative to deploying manned aircraft or building physical barriers.

b. Maritime immigration control: Pseudo-satellites can monitor coastal areas and international waters to detect and control unauthorized immigration by sea, providing law enforcement with real-time data.

10. Infrastructure monitoring and management.

a. Energy Infrastructure Monitoring: Solar UAVs can monitor critical infrastructure such as power lines, pipelines and wind farms. They can detect potential hazards such as leaks, wear or damage, ensuring timely repairs and maintenance.

b. Traffic and traffic monitoring: Pseudo-satellites can monitor traffic patterns and infrastructure such as highways, bridges and railways. They can also provide information about traffic congestion and help with smart city planning.

Result.

Tropospheric solar energy pseudo satellites have many potential applications. Their long-range flight capabilities and ability to remain stationary over a certain area make them particularly suitable for tasks requiring constant surveillance or communication in remote or difficult environments, especially when performing special tasks. As technology advances, these UAVs will play a critical role in bridging the gap between ground infrastructure and satellite systems, offering cost-effective, sustainable solutions in a variety of industries.