Special Operations Forces Eye

Proposed Solution

The idea focuses on following points:

- **The use of Advanced 3d Printing or Additive Manufacturing & Embedded Electronics to overcome constraints like volume & mass(Suggestion: Mass can be further reduced by using Carbon Fibre). More than enough space can be reserved for coarse sensors and other important payloads.**

- **For Attitude Control, embedded electric propulsion system, micro pulsed plasma thrusters (μ PPT) are suggested keeping into consideration the safety of CubeSat.**
- **Because of advanced 3 d printing rapid prototyping can be achieved easily.**
- **Advanced 3d printing is suggested to fabricate whole & integrated system rather than printing only specific components while embedding items like propulsion, antennas & other electronic components into the printed structure.**

Proposed Solution advances the state of CubeSat technology. It is feasible, novel & innovative.

Proposed solution suggests Advanced 3d printing & Advanced Embedded Electronics. With the help of these Mass & Volume constraints can be overcome easily. Also it is cost effective & will be built rapidly because of introducing 3d printing.

Proposed solution aims at expanding CubeSat capabilities to directly support SOF missions & utilizing upto 1.5U Volume & restricting mass not more than 2.7 Kg, simultaneously conforming "Conformity" & "Durability" provided. Proposed 3U Cubesat would

have dimensions 10cm x 10cm x 30cm & it will be viable for a prototype demonstration within 12-24 months.

With the help of Advanced 3d Printing each component of CubeSat can be customized rapidly to have required volume & enough space. A significant number of components can be made by 3 d printing matching the requirements with respect to the size to have desired CubeSat. 3d printing will facilitate the ability to embed electronics and wires to have enough space for payload. During the process, the obstacle of embedding items like propulsion, antennas & other electronic components into the printed structure can be resolved by using 3d printing to fabricate whole & integrated system rather than for just using it for printing specific components.

Antennas can be embedded. 3d printing techniques can be used to increase the integration of subsystems into the CubeSat structure itself, allowing a significant portion of components like antennas, feed networks, connectors, electronics to be embedded within the structural walls of CubeSats and thus increasing available payload space.

3d printing can provide the way to neatly package electric propulsion system within the structure for efficient attitude control, reserving valuable internal space for coarse sensors and other important payloads. Regarding electric propulsion system, micro pulsed plasma thrusters (μ PPT) offer a system which can be tightly packaged, easily printed, and that provides sufficient propulsive capabilities for attitude control & bus stability.

Size of Proposed Solution

3U Cubesat: 10cm x 10cm x 30cm

- **Standard 3U host-side basic avionics takes up 1.5U, leaving <1.5U available for a payload.**

Payload Volume: Range from 1.5U

Payload Mass: Up to 2.7kg for a 1.5U payload

CubeSat helping Special Operations Forces missions:

1. To have maximum coverage or Field of View, CubeSats can be launched to Geostationary Equatorial Orbit (GEO). CubeSats placed there will see entire hemisphere of the planet as long as they are in that orbit.

2. The suggestion of using Ka band can provide following advantages to the Special Operations Missions.

- **Less congested & highly efficient.**
- **Higher Ka-band operating frequency enables high bandwidth data throughput (10Mbit/s...500 Mbit/s+)**
- **Ka-band satellite broadband is a proven technology, delivering high speed services.**
- **Ka-band introduces higher download and upload speeds at lower cost.**

So it will improve the responsiveness of space capabilities and provide Special Operations Forces operators with tactically relevant information by reducing tasking and data dissemination timelines. It will help Special Operations Forces missions by transferring audio, video, and data files from man-portable, low-profile, remotely located field units to deployable ground stations terminals using efficient Ka-band.

3. Volume & Mass constraints are overcome by using advanced 3d printing & embedded electronics to make CubeSat efficient & thus reserving enough space for Payload(communications, radar, and camera).

Energy Management system in CubeSat

Here is about energy management system that combines power generation, storage and heat rejection in the compact CubeSat platform as well as system that enables electric propulsion.

Platform accommodation requirements for power.

Power System for 3U CubeSat

- **Electrical Power Supply(EPS) Unit**
- **Lithium Batteries**
- **Solar Panels**

Main features:

- **Photovoltaic power up to 60 W-100W**
- **Two regulated power buses: 3.3V@5A and 5V@4A.**
- **Up to six 3.3V@3A outputs.**
- **Up to six 5V@3A outputs.**
- **Battery capacity: 2600-5200 mAh**

Platform accommodation requirements for thermal control.

Thermal Control Louvers are suggested for thermal control.

Benefits

- **Requires no power for thermal control, as it provides passive actuation of flaps via bimetallic springs.**
- **Can be customized while still maintaining a standard form factor; the modular design can be produced in large quantities and swapped into various sized plates according to the need of CubeSat for thermal control.**
- **Having multiple bi-metallic spring design, so if one spring fails then only one pair of flaps will be inactive.**
- **It can be 3d printed to create lightweighted, easily reproduceable flap.**

Platform accommodation requirements for data transfer rate & data transfer volume (per orbit).

SWIFT-KTX - Ka-band transceiver

SWIFT-KTX is a re-programmable software defined radio that combines significant onboard processing power with a wideband K/Ka-band transmitter.

The SWIFT-KTX is a Ka-band transceiver that can provide high-speed uplink and downlink capability at frequencies of 17-36 GHz with 100 MHz of bandwidth.

Availability: EM expected 2018Q3

Platform accommodation requirements for bus stability and attitude control:

Since CubeSats in Geostationary Equatorial Orbit (GEO) will have certain limitations with magnetic torque rods or momentum wheels. So electric propulsion system, micro pulsed plasma thrusters (μ PPT) can be utilized for bus stability & attitude control. Micro pulsed plasma thrusters can be tightly packaged, easily printed, and can provide sufficient propulsive capabilities.

Additional Development Requirements:

Advanced 3d Printing & Embedded Electronics are suggested to overcome volume, mass constraints & to reserve enough space for payload. Micro Pulsed Plasma Thrusters (μ PPT) as electric propulsion system for attitude control are to be embedded in the 3 d printed structure. Skilfully embedding items such as propulsion, antennas and other electronic components into the printed structure requires a little advancement in techniques. Rather than just using 3d printing to print specific components, the effort can be focused to fabricate a complete, integrated system.

Thanks for going through above.