Design a satellite constellation of a single LiDAR emitter and a swarm of receivers

Mission Objective: A micro payload satellite constellation of a single LiDAR emitter and a swarm of receivers.

1. Be able to detect more reflected photons compared to a single detector

* Multiple detectors
* Spatial resolution of 50 m in ground direction, 0.2 m in vertical direction [1]
* Budget lower than the ESA budget for comparable satellite missions
* Use Componets-Of-The-Shelf technology
* Better data performance than a single receiver
* Ability to identify topology and ground cover
* Altitude of 600 km, 94o inclination
* Mission lifetime of 5 years
* Solar powered
* Link budget of TBD
* Pointing accuracy of
  + 1 deg on all axis for the emitter (1.4 deg max) [1]
  + 1 deg on all axis for the receivers (1.6 deg max) [1]
* Positioning accuracy of TBD
* Receiving rate larger than 2 photons per pulse
* Mass below TBD
* Sustainability
  + Decommissionable
  + No hazardous materials

[1] <http://cosine.nl/?id=silat>

Functional requirements: What does it do?

* Emit laser pulse
  + strong enough
    - Enough power generated by solar panel
    - Battery for having power in eclipse
  + be received
    - send pointing data to receivers
      * Synchronised clocks
  + get data
    - spatial ground resolution of 50 m, vertical of 0.2 m [1]
    - Position accuracy of 15 m
  + Nadir pointing
* Receive returning photon
  + Point to the ground target
    - Receive pointing information from the emitter in time
      * Synchronised clocks
    - Relative position accuracy of 15 m [SMAD 504]
  + Perform better than a single large receiver
  + Battery for having power in eclipse
* Create a digital terrain model
  + Data processing
    - Simulator for pre-flight testing and verifying results
    - Statistical mathematics for analysis
  + Data download
    - Link to space segment
      * Link budget of TBD
  + Data storage
* Sustainability
  + Decommission
    - No hazardous materials used
  + Use renewable resources for manoeuvring
    - Solar panels, control moment gyros

Operational requirements: How does it get to do that?

* Duration
  + The system must work for 5 years
    - Replacements of part of constellation possible
* Availability
  + attitude 600 km, inclination of 94 deg [GLAS] for coverage of most of the Earth
* Mass
  + TBD
* Cost
  + Below cost of comparable ESA mission\
* Emitter
  + pointing accuracy of 1 degree (1.4 deg max) [1]
* Swarm
  + Pointing accuracy of 1 degree (1.6 deg max) [1]

Design options

Communication

* High-High to Low
* High to Low directly