System development of an experimental rocket for launching campaign organized by French association Planete Sciences

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This paper presents system development of an experimental rocket for launching campaign organized by French association Planete Sience (http://www.planete-sciences.org/). The two-staged experimental rocket is developed by 'Space Club-Gifu' and Sasaki Lab. in Gifu University. It has the velocity sensor, GPS, pressure sensor omni-directional video camera and the video camera on board. The purposes of our experimental rocket are as follows:

1. Two cameras monitor motor combustion and activity of the flying rocket.

2. Accelerometer, pressure sensor and GPS sensor is to compare with simulation data such as acceleration, velocity and position.

3. New mechanism of the separation system is to make 2008 rocket with two engine motors.

4. Quasi-satellite will come back autonomously to the target position using GPS data.

The CNES and PLANETE SCIENCES qualify as an experimental rocket any rocket that matches the following points:

The rocket is created within the context of an amateur club as a team project; the team relies on a methodical experimental approach and rigorous project management. The rocket takes part in an experiment, main objective of the project.

. It is propelled by one motor, issued by the CNES.

. The rocket's conception must allow for an operation and a launch which does not breach the security regulations.

. It respects the specification book. "Book of Specifications Single Stage Experimental Rockets

(Version 2.1)," Planète Sciences/CNES (Centre National d'Etudes Spatiales), issued on 15th October, 2004.

UCG-07 Rocket is the two stage rocket and will have the several unique features such as;

1) It has a Quasi-Satellite with GPS, PIC and two propellers.

2) It has an omni-directional digital movie unit to monitor the stage separation during its flight.

3) On the first stage, the distributed controls of many functions with using several micro-computers.

4) It will be designed so that the vehicle will be reusable and ready whenever it has a payload.

The Club has the intention to join the launching campaign regularly with the same rocket and with different missions.

The overview of the UCG-07 and configuration of UCG-07 Rocket shows Figure 1and Figure 2. The overview of the quasi-satellite shows Figure 6.

Major performances are as follows, provided that the weight is approx. 15 Kg, total length 2.255 m and the drag coefficient 0.3;

Maximum Altitude: 850 meters at 13.7 seconds

Maximum Acceleration: 10.5Gs

Maximum Speed: 108 m/sec

Major flight sequences will be controlled by two main computers, and are as follows (as shown in Figure 5);

1) Trigger - by the lift off SW ------ Time count zero and initiate the flight computers.

2) +0 sec ------ Initiate all the computers and the sensors.

3) + 12 sec ------ Engage the Stage Separation Mechanism and Separate the second stage from the first stage.

Fig.1 Overview of UCG-07.

4) + 13 sec ------ Engage the parachute door of the first stage to deploy the parachute.

5) + 13 sec ------ Engage the Quasi-Sat Deployment Mechanism to throw the Sat. out.

6) + 15 sec ------ Engage the parachute door of the second stage.

These operations are quite critical since they should avoid two incidences. We would like to avoid the collision course between stages and Quasi-Satellite, and to avoid the deployment of the
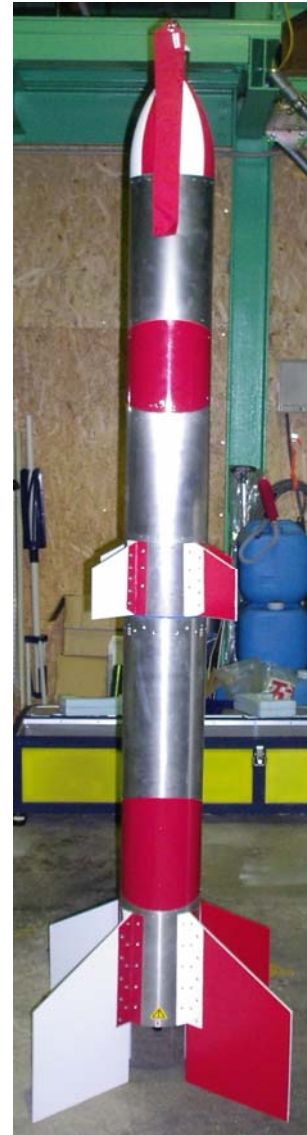
parachutes at high speeds. In the above sequence, we would like to engage the parachute door of the 1st stage soon after the stage separation so that 1st stage will be left behind to avoid the collision with the second stage. Then 1 second later, we would like to have Quasi-Satellite deployed from the second stage. Hopefully at this moment, 1st stage should be a few meters behind the 2nd stage. The parachute of Quasi-Satellite should be deployed soon after the ejection of the satellite. Finally 2.0 seconds later, the parachute of 2nd stage will be deployed and the Quasi-Satellite will be far behind 2nd stage. From this picture, the rocket will reach its maximum height in less than 20 seconds and comes back on the ground in 3 minutes and 30 seconds.

The video on 1st stage monitored the combustion of the rocket motor. Unfortunately, the 1st stage was not recovered. Although the 2nd stage was recovered, the memories of these equipments could be restored. The omni-directional camera on 2nd Stage monitored the separation of stages and the deployment of parachutes and the quasi-satellite. The pressure sensors, accelerometer and GPS are on board. The program was a success for measuring and storing the mini-SD cards. The flight profile is shown in Fig. 3 and 4. Figure 3 shows the velocity data of the UCG-07 and Figure 4 shows the acceleration data of UCG-07.

Finally, I'd like to make some conclusion about this program of UCG-07.

- A mechanism of separation part has been improved.
- One accelerometer, two GPS, one pressure sensor, one CCD camera and omni-directional camera have been implemented on.
- A quasi-satellite that autonomously come back to the target point has been developed.
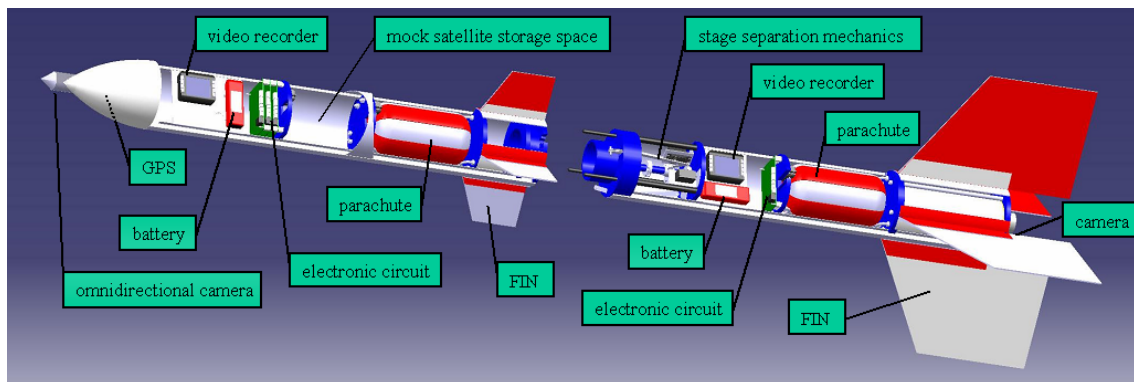
Fig. 2. Configuration of UCG-07.
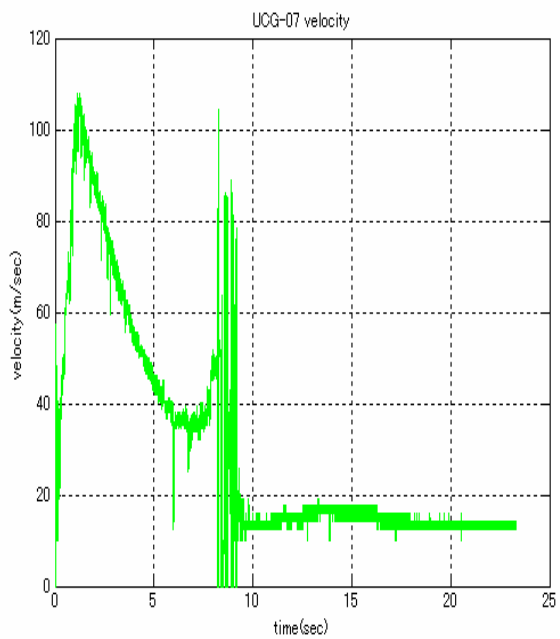
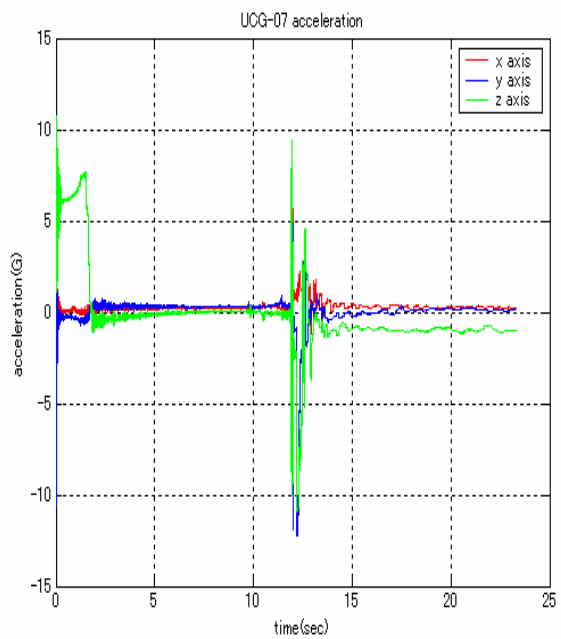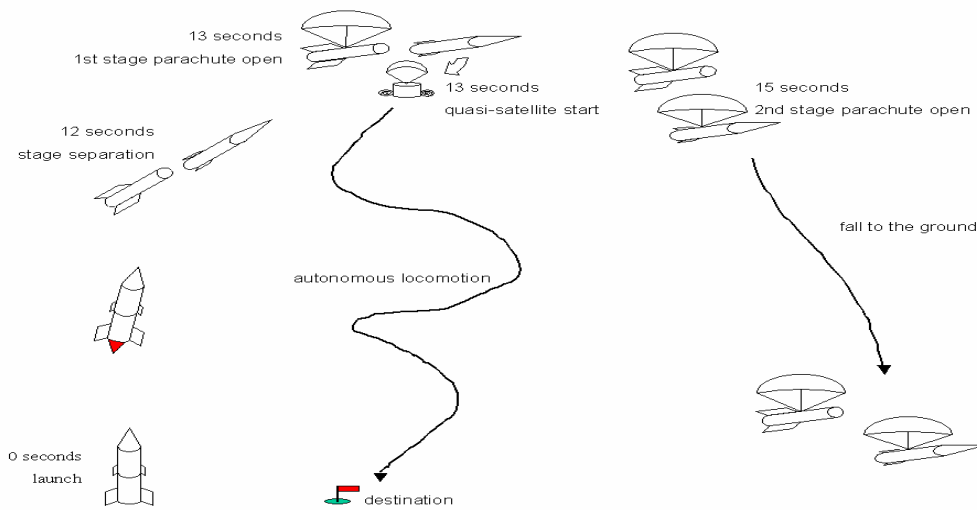Fig. 3 Velocity profile of UCG-07.   Fig.4. Acceleration profile of UCG-07.
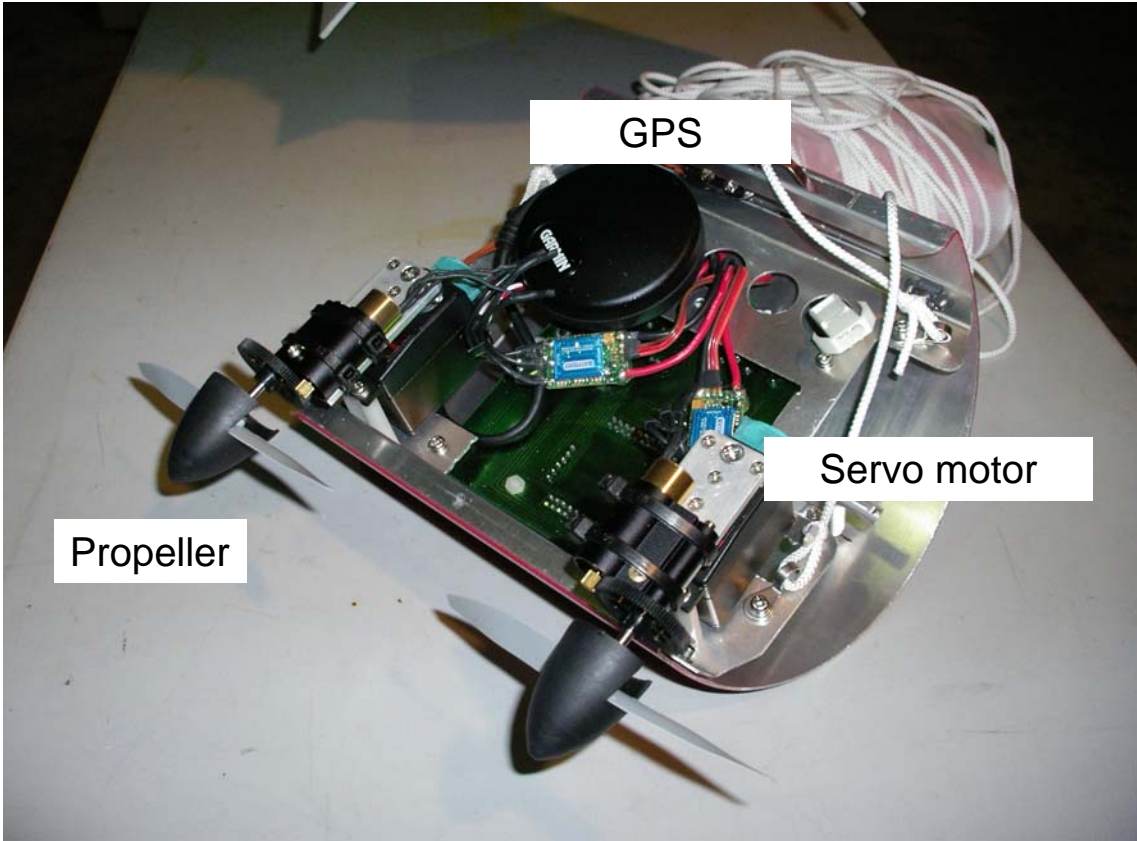

Figure 5. Time sequence of the UCG-07.

Figure 6. Overview of the Quasi-satellite.