46th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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MATRIOCHKA, ADVENTURE AND ACHIEVEMENT OF A TWO-STAGE ROCKET MADE BY FRENCH STUDENTS FROM ESTACA

Abstract

Matriochka is a rocket built by a student team from ESTACA, a leading French school in space engineering. This project was a challenge because the rocket was designed and built by ourselves in our free time. Matriochka has two main specificities: two stages (Stimulus Reflex) and a reusable stage. The rocket was launched during the C'Space, the French launch campaign for amateurs. Clubs from all over the world come each year to launch rockets, cansats and balloons. This main event is organised by CNES, the French space agency and Planète Sciences. Matriochka was an atypical project for the C'Space because since 1997, 10 two-stage rockets were designed for this campaign but only 5 were launched and only 2 were allowed to ignite the second stage (the first one was a Japanese rocket in 1997). Therefore Matriochka was the third one with a second stage ignited and the first one with all securities compliant to CNES requirements. Then, Matriochka was also unusual because of fins configurations: profiled fins for Stimulus (1st stage) and circular fins for Reflex (2nd stage). Unfortunately the software used by the CNES was not able to validate these concepts. We had to create new validation methods and test extensively to convince them. Moreover, Stimulus was designed as a reusable stage: robust structure, limitation of the consumable products, maintenance minimisation between two launches... In fact Reflex was a rocket itself and we would like to offer Stimulus to embed rockets from other clubs as 2nd stage! That is why Stimulus was made flexible. We can adapt the fins (size and position) for the stability and we designed standard interfaces between both stages. Last particularity was the context. Actually engineering work and 90Matriochka was launched successfully in Tarbes (France) on the 23/07/2017 and all data (measurements and videos) validated the concept: stages' separation, recovery systems, flight sequential with safety conditions and stability of both stages. Finally, everyone learnt so much in technics, management, system engineering, manufacturing, outreach... For us the project was an adventure and the result was a reward from all of efforts provided! Now we are ready to use these results, maintain the launcher and launch again. To summarize Matriochka was a mix of challenge, humility, work and fun!