

13th ESMATS – Vienna – Sept 09

Dear committee members,
Ladies and gentlemen,

On behalf CNES , the French Space Agency, I am very glad to be, once again, among this worldwide mechanism engineers community, to tell you a few words as an introduction of this 13th edition of our ESMATS symposium in this marvellous historical city of Vienna. I am also very happy to see this symposium moving towards a new country, Austria being, I believe, the 9th European country to host this symposium. Many thanks to the RUAG company, the local organiser, for giving us the opportunity to meet in such a wonderful place.

Mechanisms and tribology are considered since many years in CNES as major technical fields to be carefully mastered because they are directly linked with single point failure in most of orbital systems design. In fact, it is true that tribology under vacuum and microgravity is a quite specific technical domain, that you didn't learn at school and for which individual experience and lessons learned are essential. For that reason, CNES has worked for many years with university laboratories in Lyon to help the understanding of the physical phenomena thanks to elementary tests made by high level specialists, to describe accurately the friction surface transformation behaviour and to make a link with theoretical approaches. Special vacuum test bench with a visualisation of the friction interface was developed to help the explanation of wear particles or fluid meniscus dynamic behaviour. But CNES decision was also to perform internally components or mechanisms vacuum tests to make young engineers aware of the friction behaviour of various materials, geometries and lubricants, making their own experimental measurements. They can experience by themselves the high impact of small details in the test conditions, and this will benefit to all space projects they may support in the future because you never forget what you have learned by yourself.

On the opposite side, the whole mechanism design is a "crossroads" of wide range of competences that makes this job very attractive and often fascinating. Making a moving subsystem for years and years without a single human maintenance is unimaginable for people who are not working in the space industry field. We have the great chance at CNES to gather specialists from all space disciplines at the same place, including people from software and ground control segment, that allows us a quick and global analysis of any in orbit anomaly to search for a cure and restore the mission as soon as possible. In 2009, CNES is operating 17 satellites from Toulouse space centre, among them 15 are in low Earth orbit and 2 in GEO. The lessons learned thanks to the data coming from these satellites are collected in a company data base and are used firstly to propose improvements of the ECSS standard in case of need, and secondly to help the review teams to ask relevant questions in the frame of new projects. They are also used to exchange warnings with ESA/ESOC operation centre during regular meetings.

For all the mechanisms used on these satellites, analyses and ground representative tests were always mandatory because the interaction between a lot of influence parameters makes the border between a success and a failure very narrow.

Last July, we have performed the Earth observation SPOT 2 satellite de-orbitation to comply with IADC recommendations, after more than nineteen years of activity. This

satellite was designed for 3 years lifetime, and after 19 years, most of the platform redundancies were still unused. For example, the three nominal mechanical gyroscopes moving permanently at 200Hz with wet lubricated ball bearings have performed, without any failure more than 10^{11} revolutions, that breaks, in my opinion, the world record of ball bearings revolutions without maintenance. When you say that, people answer you that you have made “overquality”. But when you look at the definition file and you wonder how you could have saved money without going down to “underquality”, and when you calculate the additional cost induced by ground tests anomalies or by in orbit failures inquiries, you come to the conclusion that you have chosen the cheapest and so the right option. In my opinion, speaking about overquality for space mechanism life time is nonsense.

Some words about recent CNES mechanisms events:

Among the main 2009 events, I can mention the first in orbit use of the low shock PYROSOFT release nut on the two SPIRALE spacecrafts and the recent switch on of the SPIRE corner cube mechanism onboard the ESA Herschell satellite. CNES has also delivered the CHEMCAM instrument to JPL for final assembly on the new big Mars rover of the Mars Science Laboratory mission. A paper on the CHEMCAM refocussing mechanism will be presented during the symposium. By the end of this year, CNES will deliver to the ISRO Indian agency the two SCARAB and SAPHIR radiometers, each of them with a long life time scanning mechanism for the Megha Tropiques mission aiming at the learning of the atmosphere radiative exchanges in the tropical zone.

We’ve obtained also in 2009 the functional and lifetime qualification of the rotating piezo mechanism of the scalar magnetometer payload for the SWARM ESA mission. More than fifty thousands revolutions under vacuum have been performed on this resonant piezo motor taking into account the ECSS margin.

In the coming months we expect to launch a new Earth observation satellite with several shape memory alloy release mechanisms, and next year, the first Pléiades satellite will be launched on a Soyouz rocket from Kourou. New mechanisms will fly for the first time on this spacecraft as for example the control moment gyros made by Astrium for agility and a new static solar array with stiffening devices to comply with the manoeuvres torques.

Early 2010, CNES will launch the PICARD microsatellite based on the Myriade platform and dedicated to the sun activity study thanks to 3 instruments, one Belgian, one Swiss and the French SODISM pointing telescope with two fine piezo actuators, the shutter and the fine pointing stage made by the “Latmos” scientific laboratory.

I just would like to finish my speech by telling you we are lucky to work in a technical domain well suited for non routine-minded persons, who still have pleasure to learn things all along their career. I wish all of you to learn something from your colleagues and from the presentations during the symposium, but also to teach your colleagues something from your own experience. This will contribute to our community reinforcement and technical excellence.

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