

THE EUROAVIA MAGAZINE



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INTERVIEW TO KLAUS SLENZKA



"During your career, you participated in six space shuttle missions. What were your experiments and how was the work with the astronauts?"

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TECHNICAL ARTICLE FROM S. A. SANCHEZ

"The technology used in aerospace applications is very advanced [...]. However, the aerospace field is under continuous improvement [...]. Some of the main current goals are related to the reduction of costs and the building of more eco-friendly aircraft and spacecrafts."



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FROM SPONSOR



"ITAérea and EUROAVIA have common synergies and develop joint projects. [...] EUROAVIA's events are always very professional and well-planned, in view of the youth of its members."

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From the editor

THE EUROAVIA MAGAZINE

EDITOR IN CHIEF

Valentina Luchetti

EDITORS

Antonio Luperini
 Francesco di Lauro
 Gero Förster
 Gonzalo Díaz
 Guglielmo Cellera
 Lidia Motfolea
 Mattia Maltauro

CONTRIBUTORS

Yağmur Gençoğlu, Kaya Gravis,
 Vachan Kemthoor, Fernando Ruiz
 Vincueria, Chiara Amato, Said
 Abouli Sanchez, David Leiser,
 Michele Lucrezia, Saverio Stefanon.

PHOTOS

Gonzalo Díaz
 Lidia Motfolea
 Fabio Ventura
 Otto Wirtanen

GRAPHIC DESIGNERS

Mattia Maltauro
 Joe Pearson

ENGLISH CHECK

Melvin Benny
 Richard Morrell

CONTACTS

Press Working Group
press@euroavia.eu

EUROAVIA International
ib@euroavia.eu

Delft, The Netherlands
 Kluyverweg 1, 2629 HD Delft
www.euroavia.eu

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Dear reader,

I am very glad and proud to present to you the first edition of the EUROAVIA Magazine.

EUROAVIA, the European Association of Aerospace Students, aims to:

- Connect European students with an interest in the aerospace sector and provide opportunities for them to meet, exchange and learn on all levels;
- Associate its members with companies, making for the former the transition from university to the work environment easier and providing to the latter highly qualified students.

Therefore, in line with these principles, the Magazine includes:

- A Newsletter, the primary product that during the year allows the Affiliated Societies to discover what happens in the association;
- Interviews to professionals and professors to bridge the gap between students and them;
- Technical articles to showcase some of the smart minds inside EUROAVIA.

I hope you will enjoy it and I hope you will be able to better appreciate while reading the passion, hard work and professionalism that are at the core of our amazing association.

Finally, I really want to thank everyone that has collaborated with me in accomplishing this work.

Let's build the wings of our future together!

Sincerely,

Valentina Luchetti
 Press Working Group Coordinator



Introduction to the Newsletter



DURING the Business Year, EUROAVIANs get to know the news from the association and the exciting events that are taking place around Europe, thanks to the EUROAVIA Newsletter. It is a digital product where International Board and Local Groups reports are collected and put together to allow an exchange of ideas for local groups activities and ensure smooth communication amongst all our network.

In this section, you are going to read some of the best contributions published in different Newsletter of the past Business Year, starting from a letter from the International Board that just took office, two interesting International Events reports, the Fly-In Paris and the Symposium Toulouse and last but not least two Affiliated Societies articles, one from AS Seville, the biggest AS with more than 300 members and the other one from the new born AS Padova, whom have completely taken to the EUROAVIAN spirit and is definitely building its wings.

Finally, for every Newsletter issued the Press WG creates some quizzes to train the curiosity of EUROAVIA members. Three of them have been reported here to give you the opportunity to challenge yourself and discover how much you know about the aerospace world.

Have a nice trip through our world.



Newsletter

From the International Board

Dear beloved EUROAVIAns,

This is the first letter from the current International Board of EUROAVIA. After a beautiful and tiring experience of AMEAC Bucharest; we, all the members of the IB, have started working immediately and I can, without a doubt, say that we all love what we are doing now and we are really happy to be where we are right now.

During the Congress, with all the participants, we have been through a lot of things. Alumni meeting was a great chance for all the participants to improve themselves with the kind and considerable help of the Alumni. On the first day of the Congress, the motivation and the fun they had could be easily seen on everyone's faces.

Then, the challenging five days had begun. We met a lot of new people, a new city, a new country. We discussed the future of our association, we made important decisions. We founded new Working Groups, we accepted new members to our family. I want to congratulate and welcome all of them. Our family is growing, and I am really happy to see it growing healthily. We had the moderation of EUROAVIA handed over. The current International Board is happy, motivated, and grateful to the Former International Board. They have been the perfect teachers, tutors, friends.

I know that this new Business Year will bring us more success; and I am glad that we will all be a part of this success. Despite all the challenges, I can not wait to celebrate our achievements all together. And I, on behalf of the International Board, invite all those reading this letter to contribute to our association, to be an active part of our family.

I believe that we can do everything we want, with the help of the friendships we form, the love we have, the support of our beautiful family. May this Business Year be the best you ever have. Share the EUROAVIA spirit. Looking forward to seeing you around Europe.

Cordially,

Yağmur Gençoğlu
International Board 2016/17 – Secretary

Local Reports

Sevilla



Hello EUROAVIAns!

As the year 2016 is coming to an end, a new business year has just begun for EUROAVIA Sevilla and we can proudly say that things are going fantastically well.

Not only because we have reached more than 300 members (which is unbelievable), but we are also talking about the fact that those students are really active in both the local and international levels.

In the local view, we have already made four technical visits, including Airbus Cádiz, Morón Military Airbase, 'El Copero' Airbase and INTA, and we are preparing a lot more. In order to give you an insight of

how interested our members are, we can tell you that just ONE SECOND after the applications for Cádiz were opened, the 50 places for the event were already covered.

To be precise, the 21st of October we visited two of the biggest companies in Cadiz: Airbus Puerto de Santa María and TITANIA, where our members had the chance to discover the world of manufacturing. Then, we had a meeting with people from AS Cádiz as they prepared us some typical Spanish 'paella'. A lot of friends were made and experiences shared.



During November, AS Sevilla visited two military airbases: Morón and 'El Coperó', where members were able to see the famous war aircraft "Eurofighter Typhoon" and the take-off of a "Super Puma" helicopter, respectively. 50 people attended each of the events. Then, we had the chance to visit INTA (National Institute for Technical Aerospace Research) where we got to learn about the certification process of UAV's.

But this is not everything. This year we have also started what we want to become a tradition: an introductory course in C programming for more than 40 students, assisted by José Delgado, a prestigious doctor at the University of Seville. We think that this will aid our members with future projects. In addition, we are organising a rocket workshop that will start in February and we can't wait to get it up and running.

Meanwhile, on October 16th we successfully conducted our amazing BBQ in the 'Parque Porzuna' close to Seville. More than 200 people attended this social event and it was a success in all ways (we recommend you to watch the video on our Facebook page, because it is really difficult to put it into words): tremendous atmosphere, a lot of food, great people and even better artists – actually, they couldn't stop dancing and singing.

On the international level, we are glad to announce that 8 new members have joined a Working Group by the start of the year - apart from the ones that we already had – and we are looking to introduce a lot more. Also, people are really interested in international events, with more than 20 looking to apply for Samsun and Thessaloniki, and for sure they will take part in the following ones. We have overbooking!

Furthermore, we are organising a double exchange for the next fall with both Napoli and Stuttgart. We are firmly promoting all these kind of events because we think that it is a great opportunity for our members to interact with other cultures and also because we feel like we can expand our success locally to all the other AS from EUROAVIA. We will keep you updated about the details!

Regards from Seville, and see you around Europe!

Fernando Ruiz Vincueria

Paris – Fly-In Paris – Le Bourget 2017



From the 22nd to the 25th of June 2017, 20 EUROAVIANS were welcomed in Paris by 20 other EUROAVIANS!

THURSDAY 22: Some Paris-EUROAVIANS fetched the newcomers at the airport and took them back to their hostel. For those who arrived early, they could visit Montmartre, going on foot to the Sacré Coeur and see some artists painting their faces. Afterwards a dinner at the hostel was organised, with Paris-EUROAVIANS cooking pasta salad. Therefore, we got to know each other.

FRIDAY 23: LE BOURGET! Wake up every one! 8 o'clock meeting point at the hostel. After travelling by public transport and standing in the line, a lot, we finally arrived at the Paris Air Show. First of all, we had a bit of free time around the stands. We got to see many planes and interesting professionals. Then, it gets even better. We met at the SAFRAN stand where waitresses, croissants and orange juice were waiting for us. The HRD deputy made a quick presentation of his job and led us across five German stands where professionals from aerospace industry presented their work and inventions. The lunch was even more impressive! We were seated in a luxury restaurant when we heard the first Airplane burst. We almost ran outside only to discover we had a private terrace that overlooked the take-off runway. We stayed agape in front of the planes until we were told we wouldn't have time for desserts. It has not even finished yet! After the lunch, we were taken to a lounge where we could experience virtual reality and have close access to several planes not open to global public. We were guided inside the Airbus A380.



We were able to sit in the cockpit and appreciate the making of this huge plane. We finished the day with the spirit night! You will have to go to the next international event if you want to know what happens during those crazy nights.

SATURDAY 24: SCEAUX AND THEN PARIS! This bright day began with a tour of our school in Sceaux and a stroll around, passing by a lovely park of the city containing a small castle. We wandered around, taking pictures of us and enjoying the sun. Then, a EUROAVIA trainer, Vladimir from Berlin, presented oral skills in one of our classroom while the organisation team was preparing the barbecue. We finally had a hot-dog with some nice music! After filling our bellies, we headed to Paris. This is when it became tricky. We couldn't follow the initial plan because of the Olympic games, the gay pride, and other events meant for the train station to be closed around our destination. However, the organisation team succeeded once again to make a success out of it. We got to see the events and the Tuileries gardens before going to the Arc De Triumph where we were able to stand above all Paris. The final dinner took place in the centre of Paris in a cute restaurant where wine was flowing all night long. We were all wearing pretty dresses or smoking. After this delicious meal, we all went

to the Eiffel Tower and some of us finished the night in a famous night club.

SUNDAY 25: On Sunday morning, for those who spent the day with us, we visited the Louvre. Everyone has now left Paris to go back to their homes with unforgettable memories and Eiffel Tower stars in their eyes.

Kaya Gravis

Padova



On December 2, 2016 PAS EUROAVIA Padova organized a visit lasting the entire day, which took place entirely in the Trento-Mattarello airport, named after the Italian aviation pioneer Gianni Caproni.

THE GIANNI CAPRONI AERONAUTICAL MUSEUM: The first stage of the visit was the Gianni Caproni Aeronautical Museum, close to the airport; a museum founded in 1927 by the Italian engineer Giovanni Battista "Gianni" Caproni. As a young man, he dedicated his life with passion to the aviation world. This passion led him to start to preserve some of its aircraft within their workshops instead of sending them to the demolition. From this far-sighted idea, since the 20s, it was born and developed the collection that currently enriches the museum. The first aviation collection in the world. A prepared guide led participants between engines, propellers, unique exhibits related to the world of aviation and other aircraft models designed and constructed from the early '900.



THE FLIGHT SCHOOL ITALFLY: The same day the group of PAS EUROAVIA Padova went to the headquarters of Italfly, a company which is responsible for providing air taxi services, pilots of aircraft and helicopter formations providing PPL, ATPL and LMA. The EUROAVIA group was introduced to the activities of the flight school including the new course to get APR to become a certified drones pilot. Very interesting was visiting the hangars where they were parked both helicopters and airplanes in the fleet owned by the school. The flight school made available its own certified flight simulator and the EUROAVIAns had the chance to experience it. Some members have also taken the opportunity offered by Italfly to try, under the supervision of an instructor Italfly Academy, the thrilling experience of flying a helicopter (Robinson 22) prior personalized lecture.

HELICOPTERS ITALIA: After a quick lunch, it was the turn of Helicopters Italia, a company that provides maintenance and spare parts for international helicopter operators. Helicopters Italia, in collaboration with Airbus and Safran Turbomeca Helicopters also offers a training service (consisting of theoretical and practical courses) aimed at the maintenance of helicopters. Of great interest was the ability to touch with hand the teaching material used for the training of aircraft maintenance, including for example parts of rotors and turbine engine sections. Participants were also taken to the hangar where they were able to assist maintenance operations in helicopters being able to observe especially some in advanced stages of disassembly.

HELICOPTERS CORE OF TRENTO CIVIL PROTECTION: The last part of the visit was the Helicopters core of Civil Protection of Trento. This rescue station ensures since 1959 a large number of services such as operations of the first and second rescue, operations search and rescue especially in cases of avalanches involving the use of the winch, fire-fighting operations, avalanche and material transport and persons at high altitude. The Unit is also working with the brigade of the province of Trento fire, with the CNSAS and boasts the presence of anaesthetists/intensivists, nurses, canine units and SAF units within the operating personnel. The EUROAVIA members went through the hangar where it was possible to take vision of the Core fleet. Just as one of the in-service pilots was illustrating the manner in which take place the core competence of the operations, a rescue request has suddenly interrupted the explanation, however, demonstrating the effective of flight department capacity to take off within a maximum time of two minutes. After the visit, the employees became available to satisfy the many curiosity of students.

OUR CONSIDERATIONS: Overall, the technical inspection at Trento airport appears to have largely fulfilled the expectations and in particular, there has been a lot of satisfaction among the many first and second year students. Such experience definitely allowed them to get closer to what is the aviation world in which many of them will want to dive into once their studies are over. If sometimes the study can lead to a feeling of estrangement over working practices realities that are the primary goal of any university student, this kind of activity are certainly an opportunity to bridge this gap and provide motivations to continue with more determination the university studies.

Michele Lucrezia
Saverio Stefanon

Toulouse



EUROAVIA Toulouse, based at ISAE SUPAERO, Toulouse, organized an international symposium for four days from 12-15 October 2016. 30 participants from 11 different EUROAVIA bodies from around Europe assembled at the aerospace capital of Europe to take part in this symposium. Various technical activities such as workshops, talks, museum visits, fun events, and industrial visits were organized.

DAY 1: The symposium kick started with a workshop on Computational Fluid Dynamics/Finite Element Analysis by SimScale, a German company working in the field of simulation, which went on till the afternoon when there was a contest by them among the participants to design a wing. It ended late in the afternoon and there was a talk by Tech for Space, an aerospace start up about innovation. The day ended with the traditional Spirits Night which was on campus, where the participants shared a beverage of their country/region with the others. It was a fun night with all the participants, the organizing team, and the SimScale team who announced the winners just before the Spirits Night.

DAY 2: The participants visited the Cité de l'Espace museum in Toulouse, which is dedicated to space technology. They visited the MIR space station, a model of Ariane 5, a Soyuz capsule etc. Also, there were two 3D movies about the solar system and the advancement in space technology. The feather on the cap was the opportunity to see the moon stone which was in the museum, which is one of the only two samples in France.



DAY 3: The morning session included talks by eminent personalities in the field of aerospace engineering. The speakers were: Mr. Francis Guimera, president of 3AF aviation society, Toulouse, who spoke about the safety aspect of aviation in particular about the Airbus A380; Philippe Jarry, an aerospace industry expert with key leadership roles in major aerospace players like SAFRAN, Bombardier, Airbus, and Snecma, who spoke about the future of civil aviation and who could be next major player; and Retd. Col. Philippe Perrin, former ISS astronaut, currently working as a test pilot for Airbus, who spoke about his space-walk experience and inspired everyone with a brilliant video of the same. The afternoon session had a very interesting event on studying and analyzing air accidents through a quiz and included the simulation of an emergency situation in the flight simulator present in the campus.

DAY 4: There was a visit to the Final Assembly Line of Airbus A380 along with the Airbus museum, 'Aerospopia'. Here, participants visited the hangars where the mighty bird A380 is assembled. At Aerospopia, they experienced the journey of Airbus from its early days through the good old days of the Concorde till the A380 and A400M. The final dinner took place that night which marked the end of an amazing four days.

Our sponsors for this event were: our institute ISAE-SUPAERO here in Toulouse, which has produced world class engineers over the years; SimScale, a revolutionary cloud-based CAE platform for engineering simulations; and 3AF, which is an aerospace society that deals with providing a forum for new ideas, encouraging to maintain a network of aerospace contacts, and represent its members to other scientific societies.

Vachan Kemthoor

Quiz

1. NASA Apollo space program was one of the greatest technological breakthroughs of the last century, the features developed during that period still help us in the everyday life, as an example we could consider:
 - (a) Teflon;
 - (b) Smoke detectors;
 - (c) Sport shoes;
2. Which was the first plane to break the sound barrier?
 - (a) The Concord;
 - (b) The F-5;
 - (c) The Bell X-1;
3. "Proxima Centauri b", the nearest exoplanet orbiting in a habitable zone, is around $1.3 \text{ parsecs} = 4.2 \text{ light years} = 4,2 \times 9,461 \times 10^{12} \text{ km}$ away from Earth. There is the idea to go to collect data and images from the Alpha Centauri system by lightsail-riding nanocrafts which in theory, could travel up to 20% the speed of light. How long would it take a for this probe to get there?
 - (a) 20 years;
 - (b) 75 years;
 - (c) 6.000 years;
4. Referring to the question above, how long would it take the space shuttle at its max speed to get there?
 - (a) 7.500 years;
 - (b) 48.000 years;
 - (c) 165.000 years;



Introduction to Interviews



ONE of EUROAVIA's main aim is to acquaint its members with their future working environment. So, some of the Magazine's editors, members of the EUROAVIA Press Working Group, have interviewed professors and professionals from the aerospace sector to discover the amazing feats they have achieved in their careers, how they have managed to reach them and obviously get suggestions and tips on how we could implement some of the strategies they have used to be so successful.

Many professional profiles including university professors & company chair, a scientist and a pilot are described.

Interview to Mariano ANDRENUCCI

ABOUT THE INTERVIEWEE:
Mariano ANDRENUCCI, Prof.



Mariano Andrenucci, Professor at the University of Pisa and currently Responsible for the Propulsion Division in SITAEL, one of the largest and most important realities in the private space sector in Italy. SITAEL deals with the development and design of microsatellites, electronics for space application and electric propulsion, in which Professor Andrenucci is an expert. For his work and his invaluable contribution in electric propulsion, indeed, he also won the Stuhlinger Medal in 2011, which is the highest honor in this field.

Interview by Francesco di Lauro

Hello Professor Andrenucci and thank you for this interview. You have been an expert in Electric Propulsion for many years now. What kind of studies have you done?

Hello. Well, there was no Aerospace Engineering degree course at the time, so I studied Aeronautical Engineering.

Why did you decide to study this? Was it just a matter of personal attitude?

The answer is simple. When I was young, the “future” was associated with space frontiers, space activities. Now it is not like that anymore. Most of the high-tech things are related to electronics and information technology. But if you wanted to do something really futuristic, in my age, you would think about space. Now we can take many things for granted but, at the time, no one had ever been in space and going to the Moon still seemed like science fiction. Space today is more of a sort of industrial activity, a business. If you

ask, for instance, one of the people who works here in SITAEL why they are interested in space, you will find that they are not only interested in space business but also that space is considered as something you should do because it is useful for some practical purposes. It was not like that at that time.

It was just research, so.

Not research. Yes, to go there you had to do research. But going to space seemed not to need further justifications. It was just a way of moving forward the frontiers of knowledge. You know, going towards the stars and find out about the origins of life on Earth... It is still something that may act as a fundamental motivation behind many of the things that are done even today. But now, of course, there must be also a business side that matters more than the idealistic considerations, otherwise you will not be able to do this.

Of course. When and where did you start to work?

Immediately at the university, here in Pisa. At the time, it was not so obvious that we should look in other directions. I graduated with a thesis on Magnetoplasma dynamic Propulsion. I was probably one of the very few people who was interested in this at that time. However, I could find a sort of fellowship here in Pisa to try to do work on electric thrusters and my thesis advisor was very helpful for me. Unfortunately, to do any of the things that I had in mind, it was unavoidable to find even a modest vacuum facility to test thrusters. So, initially, I started to work on theoretical modeling and I was also one of the first people to create a computer program to simulate the behavior of electric propulsion devices. Today, instead, here in SITAEL we have many facilities and one of them is the largest vacuum chamber available in Europe that is perfectly suitable for electric propulsion testing.

This is really interesting. Which is the part that you love the most of your job?

Well, there are many aspects. I love teaching, for instance, because it is a way to involve other people and share your enthusiasm. Then, I also love to have the possibility to design, build and test things. But the best part, probably, would be making things happen, dreaming something and then making it real.

What can you tell us about electric propulsion and new technologies that are developed nowadays?

Well, it has taken decades for electric propulsion to enter the realm of real applications. Now it is emerging as a winning technology but it has been considered just as a sort of a laboratory activity for many years, and so people preferred to use conventional things. For instance, we have been working until 1991 on MPD thrusters, ion thrusters and on several other devices, but no one had ever worked on Hall Effect Thrusters in western countries. They remained secretly kept behind the doors of the Russian scientists. No one, indeed, really believed, at that time, that a new winning technology could emerge from a completely different approach. Now of course, despite this, I would say that I don't expect any totally new technology to emerge even from research activities. I mean, you can arrange things as you like, you have infinite possibilities to arrange magnets, coils etc. but the fundamental principles are those. You can either accelerate the particles electrostatically or by means of the friction exerted by electrons to ions.

What do you think will be the next step in electric propulsion, then?

Using electric propulsion on a larger scale, developing thrusters working at higher and higher levels. The problem, indeed, is not with the thrusters, the problem is with the power generation. Sooner or later we will need megawatts for our spacecrafts. You cannot go around with tons of chemical propellant.

So, actually, the definition of "Low Thrust Devices" used for electric thrusters is wrong.

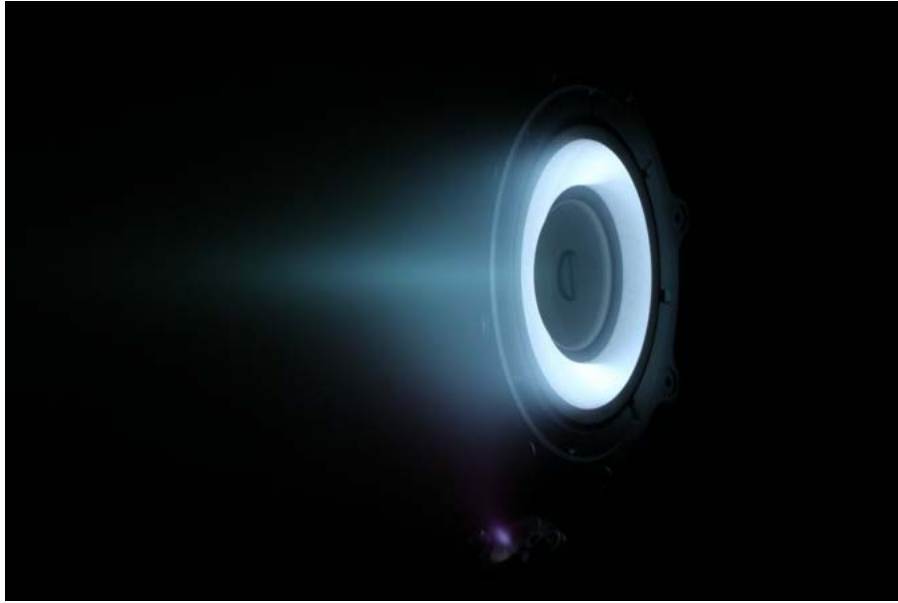
It's wrong, of course. I have always said that. These are not intrinsically low thrust devices. These are devices that can even produce large thrust levels, provided that you give the necessary power. You could use solar panels, but this can become not simply manageable at some point. You can't go around with solar panels as large as football fields. But you can do that in a much more compact way using nuclear generation, and in space you can do it quite safely. So, when it is the megawatts that are required, we will also see nuclear power generation on a larger scale in space. But before that, I think that what we have now it's enough. I mean, we can probably get to Mars without any substantial breakthrough in propulsion.

How do you imagine this field in fifty years?

Well, let's think about the automobile production. Now you can do very small improvements, but a car today is very close to what it was fifty years ago. Of course, there are enormous differences in terms of efficiency, pollution etc. but essentially it is a mature field. And I think it's the same for electric propulsion. It is approaching a phase of maturity in which we will not see any substantial breakthrough, although what we have already used today can be rearranged in new and surprising ways. For instance, let's take the Hall Effect Thruster: instead of being a single thruster with a round channel we could have a thruster with concentric channels or any other fancy arrangements you can imagine. The physical principles, however, would still be the same.

I understand. But let's change the subject, now. SITAEL is one of the most important space companies working in Italy. Are there any internship opportunities?

Yes, there are. There are people who benefit from this opportunities. Not in a huge number but here in Pisa we regularly have three/four people working on activities in many different ways, usually preparing their master thesis. They can also remain to start a Ph.D. Program and, in some cases, we can start with a short-term collaboration. Then, if the conditions are favorable, we can easily think about a full involvement. But it is not even necessary, we have a continuous turn-over. People usually spend here two or three years during which they also have to work in the international scenario and learn how to take part in meetings and technical discussion, learn how to struggle with people coming from other places. At that point, they are ready. We would be very happy to keep them with us but, in many cases, they prefer to find another place. Unfortunately, if you go to any place in France or in Germany you can be paid fifty percent more for the same level of competence. People complain about the so-called "brain drain" but I



HT400 – Hall Effect Thruster developed in SITAEL. Credits: SITAEL

think it is a stupid point because there are things that are not done everywhere. How many companies are there in Europe working on electric propulsion?

Yes, it's true and I completely agree with you. Companies are multinational nowadays, especially in the space sector. However, you also said before that people have to learn how to interact, how to make their point. What do you think about "soft skills"? Are they important?

Yes, I think they are important, but I think that the best way to learn them is just by practice. SITAEL is encouraging some of these activities. A mature industry needs this kind of things. In my opinion, if you go to an aerospace company you will probably have a better chance of success if you are good at interacting with people and effective in presenting your results. If you are just extremely good in simulating the flow around an airfoil, for instance, you will probably be left in your profession as an expert on that subject while your fellow will become the Chief Executive Officer of the company. If you enjoy research and technical work it is ok, but if you want to be a successful employee in an aerospace company that develops mature products, soft skills may become, at some point, more important than technical skills. But the university is not the right place to learn these skills. However, there will be time to improve.

So, what would you recommend to young engineers who are going to start their first job?

The problem with entering the work environment is entering. I mean, don't be too choosy initially. As

soon as you find a decent opportunity, not the best of your life, you should accept. I think an aerospace engineer should be prepared to change his job four/five times in the first ten years of his career, every time improving the situation, of course. But you should not expect to find the job for life immediately. However, you can do something in that direction also before, because you can choose a thesis work related to the field in which you think you will have more opportunities. So, also the thesis period is essential.

Has your job and your career met the expectation you had before you started?

Well, it depends on the expectations. If by expectation you mean going to Mars or becoming a millionaire of course I cannot say yes. But what is more important are not the results but the directions. Although I didn't go to Mars, I did the best I could to move in that direction. Besides, I have always been a university professor, therefore the possibility of becoming a millionaire immediately disappeared (laughter). But I could manage to set up a company, to involve other people. I also contributed as I could to, let's say, present my country in the best possible way. There are places, indeed, where Pisa is not known for the tower more than it is for electric propulsion. I mean, now there are lots of people who know that there are certain things done here at a level of excellence that has gained worldwide recognition.

And this is really awesome. Congratulations and thank you for your time.

Thank you, too. It was a pleasure.

Interview to Klaus SLENZKA

ABOUT THE INTERVIEWEE:
Klaus SLENZKA, Dr



Dr. Klaus Slenzka, Dipl. Biologist with focus on genetics and zoology (1985) and Dr. rer. Nat. in zoology with focus on neurochemistry/neurobiology (1990) both taken at the University of Stuttgart-Hohenheim, is currently the Head of Life Sciences at OHB System AG and member of the Management Board and chief scientist of Blue Horizon Sàrl.

Interview by Gero Förster

You studied biology and you are working in a space company. How did it come? What does biology have to do with space?

I studied biology, already with the interest in space activities. Very early in my life I was confronted with books from Jules Verne and others, fascinating me for space. On the other side I was also interested in biology and chemistry. Starting to study biology was a good decision. During my studies I learnt that the gravitational force is a major impact on human life and all life on earth in general. This awoke a big interest in me to study this topic further.

Nevertheless, the astronautical activities and space missions brought me to applied as one of the astronauts for the 2nd Germany Spacelab mission in 1985 (before the doctoral period at the university). So, in the end I didn't make it and had to decide differently. My decision was to make it via science. In 1993 I had my first experiment on the Shuttle Columbia, did my first parabolic flight etc.

How did you get to a job at OHB?

After the university time I was searching for a job and first got a faculty position after the opening of the permanent campus of the International Space University in Strasbourg. Through the university the connection to OHB was made. During that time OHB was searching for a biologist, who also understood the engineering. So that was the right time to join OHB.

What does your company and department do? Who is working in your department?

We are a special department of OHB. We are 50/50 aerospace engineers and biologists/biotechnologists. We have three major goals and activities. The first one is the scientific payload development, from design to operation. That means the whole process without any breaks in between. In my opinion that's the only way to act cost effectively. Because if you have different teas for the different project phases, there is a big loss of information. I've experienced this problem switching from a space shuttle mission to an ISS mission. In the space shuttle mission you, as the payload developer, were keeping in the line until the training of the astronaut. But in a payload flying to the ISS you have a break at the end of phase C/D. So others are taking

over the operational part. We saw at the beginning of the ISS how many mistakes there were.

Secondly, we are doing research and development with a mid and long term view. We are doing R/D in the frame of exploration for space and earth application. In this department it's important to work on a sustainable basis. The third activity is to have commercial services, offering products to other companies.

Which is the part that you love the most about your job?

The multidisciplinary activities. You are always doing something new. Every project is different, the people, the goal, the engineering and the science are different each time. And you meet a lot of young motivated people.

Which is the one you find more repetitive/boring?

It's boring when bureaucracy takes over. I can give an example. One of the first experiments I flew on the shuttle, we had nearly the same safety requirements as today. We had to prove that we have double or triple containment. A lot of safety requirements had to be fulfilled, but the astronaut could still perform the experiment relatively easy. Today I would have to build the box in a box in a box. So each box is an own safety level, what makes the experiment very expensive. Today, flying water is already a big safety issue. The bureaucracy in the agencies and industry makes space flight very expensive. Just compare the plans from SpaceX to land on Mars with humans in 2025 and NASA in 2035. These ten years are mainly due to bureaucracy and different philosophies. Everyone has to decide how much risk you want to take.

What does an engineer do in your department?

The engineer has to understand what is coming from the scientific teams. Then he has to be able to make technical designs, to develop new hardware, based on existing hardware. The design later has to answer the scientific question. So there are always new and demanding tasks for the engineers. Therefore the engineer has to have a high general knowledge of engineering and some training and good experience before working here.

You were trained like an astronaut. What does an astronaut training look like?

I did parts of the astronaut training during my application in 1985. Later, the parabolic flights in the KC-135 with NASA had special requirements in training. Therefore I did training together with the German astronaut Ulf Merbold. For the parabolic flights you had to get qualified at least as a passenger for a fighter flight. The tests were similar to the astronaut tests: the centrifuge, vestibular chair, vacuum chamber, rapid loss of cabin pressure, breathing pure oxygen. The only thing that the astronauts do in addition to that is the diving in the water tank.

How is breathing without air?

You breath normally, at least you think that. Because you can not re-inhale the CO₂, your physiological feedback system doesn't react. You are under control of medical doctors during the test. After around one minute you register that your sensor system in your eyes start to switch off because of the loss of oxygen and you're getting the so called "tunnel view". It's getting more and more and if you withstand very long you will lose consciousness after four to five minutes. After six to nine minutes the first brain damage will occur, you're losing nerve cells and another few minutes later you die. During the test you do not feel anything, but you do have to look on your body reactions. After 2:53 minutes I decided to put on the 100% oxygen breathing again, what was an amazing feeling. I saw others losing consciousness, what wasn't the intention from the medical doctors.

During your career, you participated in six space shuttle missions. What were your experiments and how was the work with the astronauts?

I started with the D2-mission in 1993, normally scheduled for 1988, but delayed because of the Challenger catastrophe 1986 and other reasons. In 1990 we started with the ground training and the astronaut instructions. The experiment I was responsible for was about the development of the statulitic stones in the inner ear of tadpoles and developing fish. We started to train for example Ulrich Walter and other astronauts during parabolic flights on the experiment hardware. In Cologne we had the mock-up of the Spacelab, where the astronauts were trained on how to handle the instruments and we partly developed the instrument hardware together. For me, it was an amazing time, seeing the technical, scientific and logistical questions and the astronaut training. I learnt a lot planning the scientific mission with all the equipment coming from Germany to Kennedy Space Center, setting up the equipment, considering a plan for a delay and back-up systems. Also being prepared for a landing at KSC and at Dryden air force base in California, which we had finally. Then I was involved in the IML-2 mission for Germany and further had experiments on the STS-89, STS-90 and STS-107. The STS-missions were the Closed Equilibrated Biological Aquatic System and we also had crickets and a plant physiology experiment.

The astronaut training with the whole shuttle crew started normally two years before the mission. Then we had the more dedicated training with the assigned payload specialists, doing finally the experiment. This training is very very important because you can prevent failures easily and you have to awake their interest. They have so many things to do. They very rapidly maybe lose the interest or gain more interest into another payload. If you wanted to fly a successful experiment, the astronaut had to be very interested,



Dr. Klaus Slenzka in his laboratory with a frog, the animal he sent in Space.

so if a failure occurred, he should not switch off yours but another experiment.

One of these missions was the Columbia disaster.

Sure, that was a very negative incident. In the STS-107 mission I lost friends in the crew. With Michael Anderson it was my second mission, as well as with Kalpana Chawla. William McCool the pilot, he was a very good friend and we worked very well together and especially a big supporter of our experiment.

Regarding the engineering work in your department. To whom would you recommend working in the field of life sciences?

First, you must have a high interest in space activities in general. Then, an engineer working in life sciences should have a lot of interest in hands-on working, because we've got a lot of laboratory work to do.

Nobody would start as the project leader here. Also the engineer has to have a high interest in the field of life sciences, in biology and human physiology, because he will work together with these people and has to understand their language.

How do you imagine your field work in 50 years?

In 50 years, I hope that we have the first permanent settlers on Mars and that there was a dramatic change in the thinking of the engineers. I guess, it will not take 50 years, so hopefully earlier. To fly to Mars and other extra terrestrial bodies, we need to have a different engineering and different astronauts.

Thank you for the interview

You're welcome.



Interview to Sauro FILIPPESCHI

ABOUT THE INTERVIEWEE:
Sauro FILIPPESCHI, PhD



Sauro Filippeschi, after a M.Sc. in Mechanical Engineering and a PhD in Energy/Energetic systems is currently an assistant professor at the University of Pisa since 2006.

Interview by Antonio Luperini

Where did you start to work?

I've been working both in research institutes and universities, in particular I have had close relations with the Moscow Power Engineering Institute.

Why did you decide to study this?

When I started studying Mechanical Engineering I wished to become a manager. I was attracted by important careers and the only specialization that could allow this path was Mechanical Engineering. But, when I had to study Economy in my third year I realized I hated it. In the meantime, I was attracted to thermodynamics, heat transfer and so on, so I continued to work with my professor and now I think it has been a good decision.

Do you think that improving your soft skills when you're studying can help on your work?

Yes, absolutely.

What do you think about the teamwork?

It is fundamental. Unfortunately most academic careers are not built around teamwork. There are only some projects that allow to work in a team of 2 or 3

people. Today there are very complex devices that are composed by several parts. You have to deal with software, energy transfer, mechanical stress... and it's very difficult that only one person has skills in all these fields.

What part of your job do you love the most?

I think being a professor is a fantastic experience and I love it. I like to understand the best way to explain things to people and to see how people increase their skills with my support. However, the contact with students is not so close. I just answer questions and speak with them for an hour in the examination. The best experience is the thesis or the extra-curricular experiences.

And which is the one you find more repetitive/boring?

Examination. You make the same questions a lot of times and it's boring.

Did the university/Academy prepare you enough for when you first started working?

When I finished my studies I had to learn how it is possible to write a paper and to work in the lab. You just have to start and afterwards you improve yourself every day.

What has been the most difficult situation that you have had to overcome?

Our job is divided in three different aspects: Teaching, Research and Support to organization. During my PhD my professor asked me to replace him for a lesson just an hour in advance. So, in one hour I had to prepare a two hour lesson and I was scared to speak in these conditions in front of many students. Speaking about the research, I can tell you another story. I was invited to a conference in which I had to present a paper and I arrived there a day before the presentation of my paper was scheduled. I planned to prepare it in the afternoon or in night, as I always do. However, a professor announced that he would arrive the day after and my paper was anticipated. I had one hour to prepare my presentation. I overcame this challenge but I still haven't changed my habits.

What do you think will be the next step in your thermodynamic research?

Thermodynamics is a very ancient subject; it started in the 17th century. I think the next research will be about the environmental aspect, because a thermodynamic system changes with the environment too, so it's an aspect that has to be taken in account.

Do you think there are some milestones that have to be discovered in the future or more or less everything is already discovered?

Probably in 50 years we'll be able to realize very very conductive materials and this will revolutionize the field. An example are the superconductors.

Tell me about U-Phos project. Can you give me a general overview of the program?

There is an educational program supported by the European Space Agency. The topic is to involve students from countries that support ESA in different programs. One of them is the Rexus/Bexus (Rocket/Balloon Experiment for University Students): a team must design, build and arrange the experiment inside the rocket. During the launch, students have to collect data, make a record and analyze the data. I have endorsed this program twice with Phos and U-Phos. (U)-Phos means (Upgraded) Pulsating Heat Pipe Only for Space. I have studied an innovative device able to transfer great amount of heat even without any gravity. These kind of devices are characterized by very small pipes with liquid inside. Circulation of the liquid is driven by oscillation temperature and capillarity. The diameter must be as small as we need, but capillarity is linked to the gravity. If the gravity goes to zero, diameter become larger and larger. Theoretically is possible to enlarge this device and obtain

same results in space as with smaller devices on earth. The best way to demonstrate it, it is with a sounding rocket, it has 120 seconds of zero gravity. From here the choice to participate in the Rexus project. Unfortunately, during the Phos campaign, just after 20 seconds from the launch the rocket started to spin and there was the centrifugal acceleration, the anti-spin system did not work properly and we have not been able to get good data. For this reason we decided to take another chance with U-Phos but with a different team. With the latter everything changed: the device has been redesigned, the heat transfer rate has changed, also the measurement method changed.

Which was your role in it?

I am the endorsement professor. I gave the Idea, I hosted students in my lab and also supported the team from economic point of view, buying tools need to build it. I was like a tutor for them and provided most of things necessary to the project.

How do you think this project will evolve in future?

This project has been included in a larger ESA's activity. The same pulsating pipe which we tested in the sounding rocket will be tested in the International Space Station in 2020 and companies are already working to build and test the prototype.

So the collaboration with companies will be closer and closer.

Yes, it is already close. With their help we will see if the device can maintain a good performance for a long time. This is the only way to evaluate if this innovative device is a real opportunity for space application or there are other better options in term of heat transfer and payload.

Can you tell some good reason for a student to get involved in this project?

There are a lot. You learn the importance of working in a team of students coming from different backgrounds. You have to deal with economical part, technical part. For instance, people involved in the economical part don't know anything about heat transfer, however in order to convince a sponsor you have to motivate your choices with technical explanations. The most important thing is to learn how to prepare a schedule and to respect deadlines combining different fields in one project.

Thanks for your answers and your time

Thanks to you



Interview to Andreea LITESCU

ABOUT THE INTERVIEWEE:
Andreea LITESCU, Cpt.



Litescu Andreea, after having studied at the Superior Flight School Academy is currently a Base Captain at Otopeni-Bucarest airport for Wizz Air.

Interview by Lidia Motfolea

Where did you start to work?

I started flying as a First Officer on the boeing 737 with a low-cost company

When did you start to work?

I started flying as an airline pilot when I was 23 years old.

Why did you decide to do this?

Ever since I saw an aerobatic aircraft taking-off from my hometown airfield I knew I had to be a pilot.

What do you think about the teamwork?

Teamwork is vital in aviation, where crews involve at least 2 pilots and cabin crew, also it involves communication and cooperation with Air Traffic Controllers, Ground Staff, Maintenance. CRM, which stands for Crew Resource Management, represents one of the most important aspects of non-technical skills in the Airline and all the crews have to undergo specific courses in order to understand the importance of the teamwork.

Which is the part that you love the most?

Having the best office in the world at 12000 meters helps me fall in love every time I'm taking off in the

morning with one of our fleet's aircraft. The best feeling is that every single flight is completely different than the previous and the future and helps us maintain our focus on each single detail.

And which is the one you find more repetitive/boring?

In order to assure and maintain flight safety and security every company has their own normal procedures, flows that are used for all the flight phases that are always repetitive, but never boring. I would say it is extremely important to follow all the standard procedures, this being another way of communicating in the same manner for the entire crew no matter what nationality and language they are using in their everyday life.

Are there internships opportunities in your company?

Last year Wizz Air announced the launch of a new Wizz Air Cadet Program in partnership with BAA Training. The five year agreement will recruit up to 150 cadets and will be delivered under EASA Regulations to provide Wizz Air of ATPL integrated graduate pilots. The airline is looking for passionate and devoted young people who have little or no previous flying experience who want to join the airline's motivated and high-standard team of professionals.

The program will focus on learning and developing skills that are relevant and focused towards the operational needs of Wizz Air and, with a job guarantee for those who successfully complete the course, it will enable graduates to join the airline directly as co-pilots flying Airbus A320 and A321 aircraft on the WIZZ network.¹

What would you recommend to young engineers who want to start with their first job?

I would highly recommend the same to all pilots at the beginning and every other young person at their begging in any career: to follow their dreams, to accumulate as much experience as possible, to make a long term plan and to never give up because the road to success is full of obstacles. When I decided to become a pilot I had just a dream, then I searched for any opportunity to be near to aircraft, looking for any opportunity life could offer me. It was never an easy path but every step further to my dream was so rewarding and helped me to continue step by step just like climbing a high-altitude mountain. If you believe in yourself and in your dreams and do everything to make it possible all the obstacles will disappear and for sure you will find a way to make it happen.

Did the university/Academy prepare you enough for when you first started working in the airline?

I still remember my first flight in an airline jet and how big the aircraft seemed. I was so impressed that I couldn't imagine I actually was going to fly that aircraft in few minutes during the exterior walkaround. Of course after all the knowledge and experience accumulated through the flight school, simulators and type rating when I sat down in my First Officer seat I was prepared to take-off into this lifetime experience.

What has been the most difficult situation that you have had to overcome?

Being an airline pilot within Wizz Air and flying Airbus 320/321 we are always trained for all type of situations through our simulator sessions which provide us all the skills for any abnormal situation. Until now I had only situations for which I have been trained and following these procedures the safety of the flight was always assured. I truly believe that training is highly important for any airline pilot and I'm very pleased that within Wizz Air the training is above standards.

Can you tell us something about the new technologies that your company use?

Wizz Air has a brand new fleet of aircraft Airbus 320 and 321 which are using the most modern technology from aviation field. At this moment we have 83 aircraft in WIZZ's fleet. Besides the aircraft which are state of art, we are also using ToughPads, all our books are on an electronic platform also for runway performance and the company is always searching to make the best and newest updates on the market.

How do you imagine your field in 50 years?

I am sure is going to develop and change a lot through the years, actually is quite interesting to see how many updates and upgrades appear in short period of time. I would say in 50 years aviation is going to be an amazing field to work in and this is incredible about flying that every day something new appears and you never stop learning.

¹For more information visit:

<https://www.baatraining.com/are-you-a-future-wizz-air-pilot-join-cadet-program/>



Cpt. Litescu at her office.



Otopeni Airport – Airbus A320 Wizz Air

How does the future look for your company?

Wizz Air is an amazing company based on a strong business plan and has a very experienced management team. Having such a great team of pilots, cabin crew(s), office staff and everybody involved in our company I am sure Wizz Air is going to be a successful lifetime story that everyone wants to be part of.

Do you think that the air traffic will continue increasing at this high rate?

The opportunity that aviation gives people to travel from one place to another in a short time is the best evolution and I'm sure it will continue to increase and new ways and ideas will appear in order to support and evolve the aviation field. Unless somebody will finally invent Engage button, aircraft will be the best, most safe and secure way to travel around the world.

What do you think about new models of airplanes?

I highly believe in evolution and new technology as it the only way to discover new great ideas that can be used in so many fields and not only aviation. It is vital to always adapt to change, new ideas and to be open minded to anything that might appear. That's what I love about aviation that it never stops amazing me and that there is always something new to learn.

Have you piloted several types of aircraft?

I have been flying for the last 15 years several helicopter: Eurocopter 120 Colibri, Eurocopter 155 and aircraft: IAR 46(aeroclub), Cessna, Piper, Diamond 20, Boeing 737 (Classic and NG), Airbus 320 and 321. I felt in love with the helicopters and aircraft I have flown through the years, but now in Airbus I feel home.

How many hours of flying did you have to accumulate to achieve your current position? And how much time overall would you say you have spent in the air?

At this moment I have around 7200 hours on both helicopters and aircraft types and it has been a great adventure to achieve this number of hours. I have been offered the opportunity to become a Base Captain one year after becoming Captain on Airbus 320. It was a lifetime experience taking care of Otopeni Base which has 9 aircraft and 120 pilots and I have learned more in the past 2 years than I could have imagined.

What is your most memorable flight?

Both my first flight as an airline pilot on a Bucharest –Arad-Barcelona flight and my first flight as a Captain going to Luton. I would also say that my last flight coming back from Malmo in December when I saw the beautiful Bucharest during descent for landing, by night with all the lights and thinking back how much I will miss it until my next flight now preparing for the new baby type rating.

Who is your aviation hero?

All the great people that I have met through the years and that have taught me to believe in myself and to continue my way in aviation. I had the great chance to meet so many successful persons in my life and I am really grateful for all the life lessons that I was given. Every time I need strength, focus and determination I think what they would do and I always find the best solution for my situation. I truly believe we have to surround us with great minds and to listen more to them in order to evolve, to learn and to become better versions of ourselves. I always have new goals which always helps me to be opened to any great idea.

What is your most practical piece of advice for those who want to pursue a similar career?

To never let go of their dreams as flying is the most incredible life time experience and to believe in themselves. I wish them all great memories in becoming pilots and I will be waiting for them in a Wizz Air cockpit to have an amazing flight together.



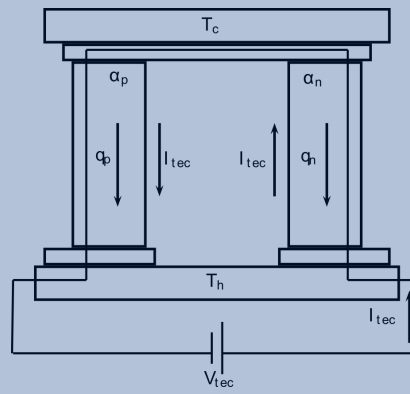
Introduction to Technical Articles



ENGINEERS are usually known as bright minds and EUROAVIA, being a huge basin of them, has got several ones.

In the following pages, you can meet three members of our association and read about relevant projects they have done during their university studies. Chiara Amato's and Said Abouali Sanchez's articles have been already published in "Aerotecnica Missili & Spazio", the journal of the Italian Association of Aeronautics and Astronautics (AIDAA).

Therefore, if you want to know more about "Finite Element Analysis of Thermoelectric-Galvanomagnetic interactions and their aerospace applications", "Chemical kinetic analysis of an alternative fuel for aircraft" and "Investigation of coherent laser diagnostic techniques for probing atomic Oxygen", go ahead and discover how much young college students are able to think big.



Finite Element Analysis of Thermoelectric-Galvanomagnetic interactions and their aerospace applications

ABSTRACT:

The technology used in aerospace applications is very advanced regarding performance and effectiveness; however, the aerospace field is under continuous improvement. In particular, some of the main current goals are related to the reduction of costs and the building of more eco-friendly aircraft and spacecrafts. One possible way to achieve these objectives is the use of thermoelectric devices. Throughout this thesis work the thermoelectric effects and their practical applications are introduced. Moreover, how the prescription of a magnetic field can improve the performance of the systems that take advantage of these effects is studied. A study of the thermoelectric, thermomagnetic and galvanomagnetic effects and their interaction is performed and their applications in the aerospace and aeronautic field are considered. The COP (Coefficient of Performance), an estimator of the efficiency, with and without magnetic field is analyzed.

1 Introduction

Thermoelectric effect is the conversion of temperature T gradients to voltage V drops and vice versa. There are four thermoelectric effects (Seebeck, Peltier, Thomson and Joule) that can be used both for power generation (current research at NASA) or for refrigeration. Military and aerospace are the most dominant markets for thermoelectric energy harvesting.

For example, commercial and military aircraft incorporate sensors and sensor networks powered by thermoelectric generators to monitor the aircraft skin for damage that can cause stresses and structural weakness. Taking advantage of the conversion of energy and heat wastes into electrical energy, aircraft are able to produce energy for on-board applications. In the aerospace sector, the Mars Curiosity

Rover, Galileo satellites or Cassini spacecraft among others are all users of Thermoelectric Energy Generators (TEG, shown in Figure 1).

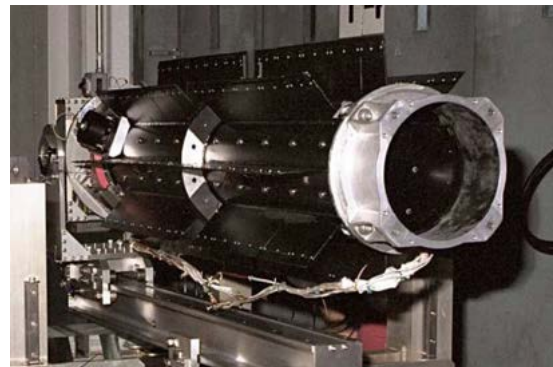


Figure 1: Thermoelectric Energy Generator that powers NASA's Mars Rover, Curiosity

Nevertheless, these effects are not completely consolidated due to their low efficiency. The prescription of a magnetic field B may improve the thermoelectric response and efficiency since new effects appear: thermogalvanomagnetic effects, the interaction between the thermal, electric and magnetic field. In this particular work, the effects are studied in the refrigeration mode (Peltier cells), but the study would be similar for the generation mode.

2 Thermogalvanomagnetic formulation

2.1 Thermoelectric formulation

The balance equations, developed in [1] and [2] and shown in (.1), relate the thermal and electric fluxes with the temperature and voltage gradients.

$$\begin{cases} \mathbf{j} = \underbrace{-\gamma \cdot \nabla V}_{Ohm} - \underbrace{\gamma \cdot \alpha \cdot \nabla T}_{Seebeck} \\ \mathbf{q} = \underbrace{-\kappa \cdot \nabla T}_{Fourier} + \underbrace{\alpha \cdot \mathbf{j} \cdot T}_{Peltier} \end{cases} \quad (.1)$$

where $\gamma(T)$, $\kappa(T)$ are the electric and thermal conductivities respectively and $\alpha(T)$ is the Seebeck coefficient. The Ohm and Fourier terms are present for every material, but the Seebeck and Peltier terms are only activated in thermoelectric materials and they are responsible for the generation of energy and refrigeration.

2.2 Thermoelectric Peltier cell

A thermoelectric Peltier cell, whose main goal is cooling, is composed of several thermocouples, each of them formed by two thermoelements ($InSb$ for this work), one of p-type and other of n-type.

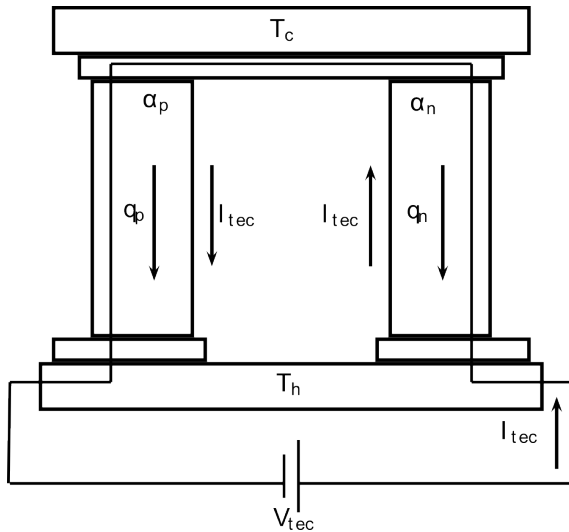


Figure 2: Scheme the thermocouple functioning

Figure 2 shows the schematic functioning of a thermocouple. Heat fluxes are created in vertical direction

since the application of a voltage difference activates the thermoelectric terms of equation (.1) and the cold face is refrigerated.

The Coefficient of Performance (COP) is defined as the ratio between the extracted heat and the input electric power, as shown in equation (.2):

$$COP = \frac{Q_c}{V_{tec} I_{tec}} \quad (.2)$$

2.3 Thermoelectric + B formulation

When a magnetic field B is prescribed, the balance equations, developed in [3], become as (.3):

$$\begin{cases} \mathbf{j} = -\gamma \cdot \nabla V - \gamma \cdot \alpha \cdot \nabla T \\ \mathbf{q} = -\kappa \cdot \nabla T + \alpha \cdot \mathbf{j} \cdot T \end{cases} \quad (.3)$$

where γ , κ and α are tensors instead of coefficients (as they were when there was not magnetic field), and they can be written, according to Landau formulation, as (.4):

$$\begin{aligned} \alpha &= \begin{bmatrix} \alpha & -NB_z & NB_y \\ NB_z & \alpha & -NB_x \\ -NB_y & NB_x & \alpha \end{bmatrix} \\ \varrho &= \begin{bmatrix} \varrho & -RB_z & RB_y \\ RB_z & \varrho & -RB_x \\ -RB_y & RB_x & \varrho \end{bmatrix} \\ \kappa &= \begin{bmatrix} \kappa & MB_z & -MB_y \\ -MB_z & \kappa & MB_x \\ MB_y & -MB_x & \kappa \end{bmatrix} \end{aligned} \quad (.4)$$

where $N(T)$, $R(T)$ and $M(T)$ are the Nernst-Ettinghausen, Hall and Righi-Leduc thermogalvanomagnetic coefficients and they activate the off-diagonal terms of the tensors, coupling the three dimensions of space and inducing perpendicular temperature and voltage gradients. The four thermogalvanomagnetic effects are:

- *Hall*: in the presence of a magnetic field, an electric flux induces a voltage gradient perpendicular to the magnetic field and to the electric flux.
- *Ettinghausen*: in the presence of a magnetic field, an electric flux induces a temperature gradient perpendicular to the magnetic field and to the electric flux.
- *Nernst*: in the presence of a magnetic field, a heat flux induces a voltage gradient perpendicular to the magnetic field and to the heat flux.
- *Righi-Leduc*: in the presence of a magnetic field, a heat flux induces a temperature gradient perpendicular to the magnetic field and to the heat flux.

If the magnetic field is applied in the proper direction, these perpendicular effects are in charge of im-

proving the COP of the thermocouple shown in Figure 2 because they may increase the temperature gradients (increasing the numerator of equation (.2)) and decrease the voltage gradients (reducing the denominator).

2.4 Finite element analysis

The set of equations (.3) together with the equilibrium equations and the proper boundary conditions close the finite element analysis problem (see [3] for detailed information). The program used is FEAP, a research program developed by Berkeley University. The elements are self programmed by the user and include all the interactions explained as well as the elastic one to obtain the stress field. Result for the COP as a function of intensity is shown in Figure 3:

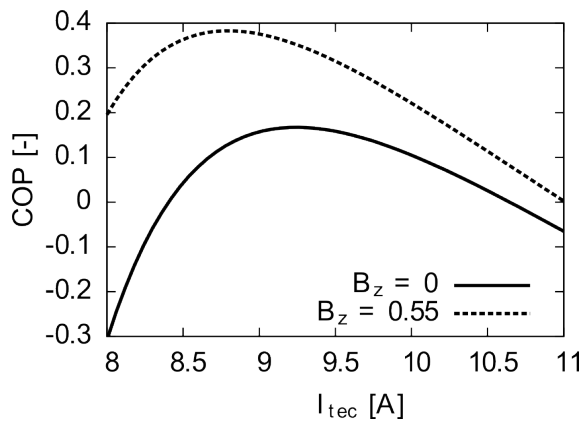


Figure 3: COP vs. I_{tec} with and without magnetic field. $T_h = 50$, $T_c = 50$ [°C]. $InSb$ thermoelements

Figure 3 shows that COP increases when a mag-

netic field is prescribed and that the intensity at which the COP is maximum decreases, thus reducing the needed electric power to feed the thermocouple. When there is an applied magnetic field of 0.55 [T], the COP reaches almost 0.4 for an intensity of 8.7 [A]. For this magnetic field, neither a lower nor a higher intensity should be used since the COP would decrease and the thermocouple would not be working under optimum efficiency.

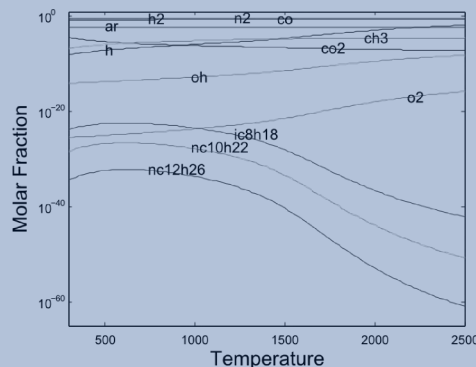
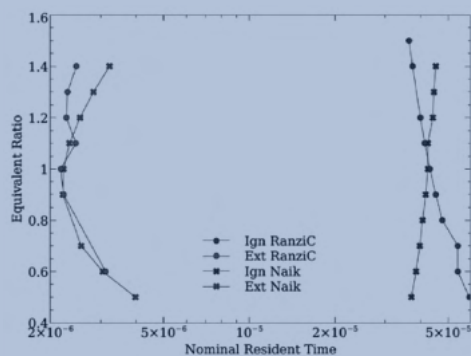
3 Conclusions and future works

Thermoelectric effects are widely used in the aerospace sector to generate energy and to refrigerate (studied in this work). However, devices taking advantage of these effects have low efficiency, impeding the complete consolidation of them. The prescription of a magnetic field in a thermocouple is one possible solution since it increases the COP, the estimator of the efficiency. Throughout the complete thesis, some other parametric studies and analysis were performed to fully understand the magnetic phenomena. One of the problem that arises is the increase in stresses when a magnetic field is prescribed. Solutions and new designs to reduce stresses and increase even more COP are proposed and introduced in the thesis and are currently being analyzed and studied for future works. Moreover, after the numerical solution, another future work is the experimental validation of the thermogalvanomagnetic effect in order to enable the later practical application in the aerospace sector. As a summary, the prescription of a magnetic field improves the efficiency of thermoelectric devices but it is a field of current research.

ABOUT THE AUTHOR: Said ABOUALI SÁNCHEZ



Said Abouali Sanchez is BSc and MSc in Aeronautical Engineering by UPV and MSc in Management and Information Systems by Cranfield University. After having interned at CERN, McKinsey and JPMorgan, Said is currently a Business Analyst for McKinsey & Company in Spain. He is passionate about space science and loves doing all kind of sports and travelling around the world with a book in his hands.



Chemical kinetic analysis of an alternative fuel for aircraft

ABSTRACT:

One of the main aspects of design aircraft engines is to verify the effect on the environment in order to abide by the increasingly strict rules for pollutant emissions. The purpose of this thesis work is the study and analysis of a new fuel derived from renewable sources. In particular using numerical methods, the behavior of chemical kinetics is carried out in transient conditions, one representative of a surrogate of Fischer-Tropsch (F-T), composed of n-dodecane, n-decane and iso-octane, and one representative of a traditional fuel currently in use on the aircraft traffic, consisting of n-decane, iso-octane and toluene. The curves of ignition and extinction are studied at different equivalence ratio and residence time for both the kinetics and then the results are compared in order to obtain guidance on the possibilities and limits of use of bio-fuels in aeronautical propulsion.

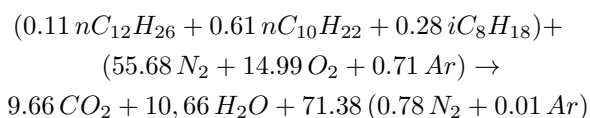
1 Introduction

This study is the result of the thesis work for bachelor's degree done at the Institute for Research on Combustion, one of the Institutes of the Engineering department of CNR in Naples. The research tries to give a small contribution to the study of alternative fuel and to understand if it is actually possible a conversion to different energy sources. The use of bio-fuels may not be so immediate: although it contributes to solve the problem of maintaining low emissions, this passage involves a lot of complexity in terms of structure and cost. The role of scientific progress is to minimize costs and necessary changes in order to implement the transition to this new family of fuels, analyzing in particular the geometry of the combustion chamber, the composition of the new fuel and its performance with better accuracy. To this day the commercial aviation has been approved two fuels not based on the crude oil: one made with the Fischer-Tropsch process (which can be coal, natural gas or biomass) and a bio-fuel derived from vegetable oils.

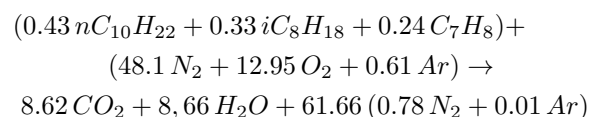
2 Description of study

A new fuel is studied and analyzed which derive from renewable sources by surrogate Fischer-Tropsch reacts

with as:



to replace a traditional fuel, a surrogate of POSF 4658, that can be represented as:



In particular the research focus on behavior of combustion kinetics in transient conditions and it is carried out using numerical methods.

The complex chemical kinetics of these fuels were approximated by reduced chemical mechanism found in literature. The chemical mechanism for alternative combustion is by Naik et al. [4] composed of 597 species and 6184 reactions, while the one for traditional fuel is by Ranzi et al. [5] composed of 250 species and 8000 reactions. First a zero-dimensional model at constant volume is identified in which the properties are independent from the geometry of the combustion chamber and from a particular motion field so that the thermochemical behavior of gas mixture in the reaction zone of the flame is investigated.

This approach corresponds to an ideal perfect mixing reactor (WSR, Well Stirred Reactor) in which it is assumed that the mixing inside the control volume is done instantaneously. In other words the mixing time is much less than the characteristic time of chemical reactions and that all properties are spatially uniform. Therefore the behavior of the chemical kinetics versus the residence time and the relationship with variations of equivalence ratio is investigated, studying in particular the ignition and extinction conditions.

Since the kinetics of alternative and fossil fuels are very complex and few information can be found in the literature about the behavior of this chemical kinetics, the study of the problem preliminary starts from the analysis of the mechanism at the equilibrium.

3 Conclusion

The results are very significant because they have allowed us to understand the span of orders of magnitude of concentrations of species participating in reactions: for Naik kinetics the interval is $[10^{-60}, 1]$.

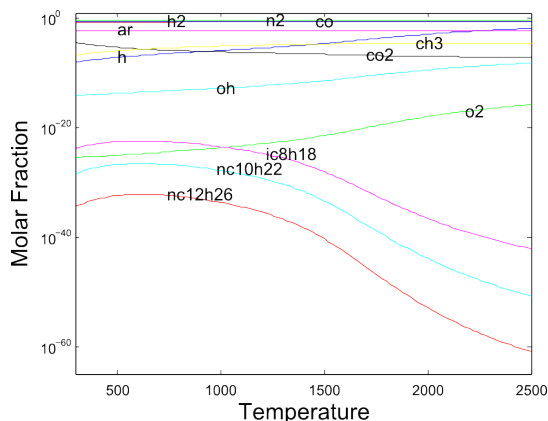


Figure 1: Molar fraction of most important species on varying temperature

The ignition and extinction curves for the alternative fuel have been then computed by numerically solving the model. By comparison these curves with the curves of traditional fuel, several considerations are derived.

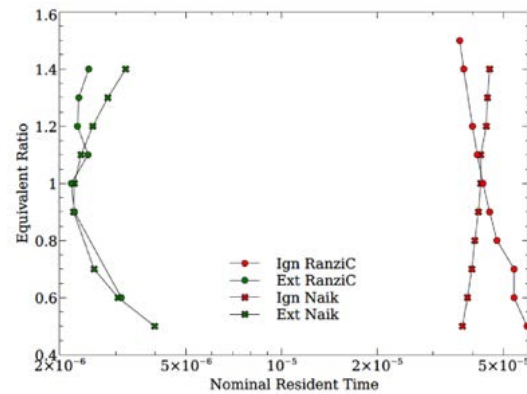


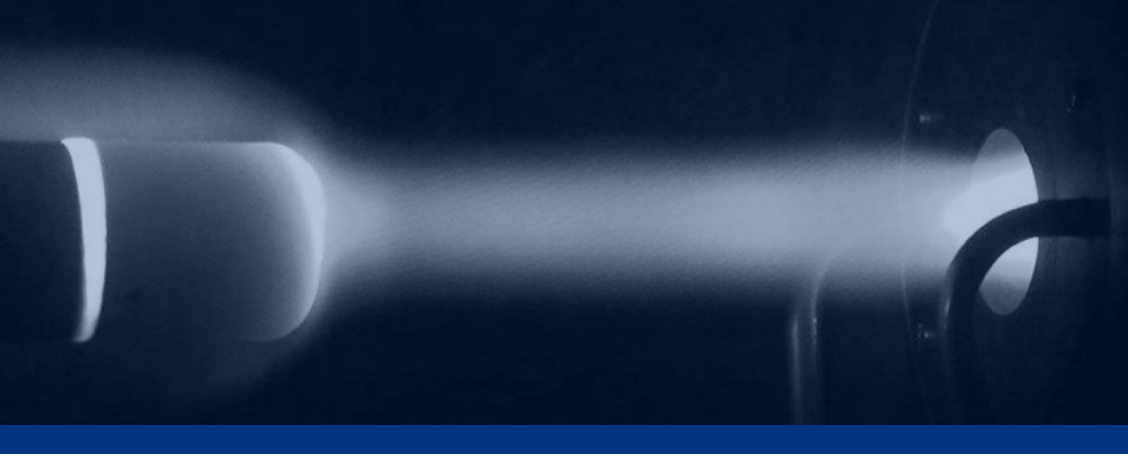
Figure 2: Comparison between the ignition and extinction curves for alternative and traditional fuel

The extinction of the kinetic behavior is more or less the same. The curves have both the same trend with a minimum localized in a range of $\varphi = [0.9, 1.1]$. The traditional fuel has smaller values of extinction resident time τ w.r.t. the alternative fuel in areas of rich mixtures, namely for these mixtures it will be able to sustain the combustion for shorter residence time. Instead, at the ignition they present the opposite behavior: while the alternative fuel is characterized by a monotonously increasing behavior with φ and then poor mixtures react earlier compared to rich mixtures, the traditional fuel is characterized by a monotonically decreasing behavior with φ and then rich mixtures react earlier compared to poor mixtures. The area between the ignition extinction curves represents the hysteresis range, i.e. the range of values of τ whereby both states are possible and so there is variety of solutions. Analysing the collection of curves it is found that the alternative fuel has a hysteresis range that varies by an order of magnitude from poor to rich mixtures, while the traditional fuel has a more regular and wider range of hysteresis. This means that the alternative fuel is a little more stable than the traditional fuel because it is characterized by a smaller range of hysteresis. In this critical region a small change in τ causes a leap of stationary solution to other condition.

ABOUT THE AUTHOR: Chiara AMATO



Chiara Amato, after the classical lyceum diploma, started the Bachelor degree in Aerospace and Mechanical Engineering at the University of Campania "Luigi Vanvitelli", ended with the thesis described above. Afterwards, she started the M.Sc. in Space Engineering at the University of Pisa. To conclude of this route, she joined the NEQRAD research team at the University of Illinois at Urbana-Campaign. She graduated cum laude while doing an internship at NASA and she has now started a PhD at the University of Minnesota.



Investigation of coherent laser diagnostic techniques for probing atomic Oxygen

The detection of atomic oxygen in its ground state is difficult due to the high excitation energy. At these energies, the absorption by molecular oxygen is significant, making measurements under normal conditions impossible. This constraint can be avoided by using multi-photon excitation methods. Two-Photon absorption laser induced fluorescence (TALIF) has been widely used to avoid the absorption problem. At high pressures this technique is limited, mainly due to quenching effects. Therefore, further techniques are being investigated in the High Enthalpy Flow Diagnostics Group at the Institute for Space Systems (IRS) of the University of Stuttgart. The TIPS, or two-photon induced polarization spectroscopy, technique uses a linear polarized detection beam and a circular polarized pump beam. Together, they excite an atom, which leads to a measurable rotation in the polarization of the detection beam.

To further investigate this technique, extensive tests using xenon were conducted. A static gas cell was used to conduct measurements in the pressure range between 10 and 110 mbar. These experiments mark the first detection of this xenon transition with TIPS. First attempts to measure in a pure oxygen plasma yielded no usable results.

The tests using xenon lead to many system improvements. The experimental setup was reworked multiple times to implement these. Additionally, a camera system was developed and tested, to observe and measure the foci as well as the overlap of both beams.

The current setup of the experiment guarantees reliable measurements of xenon at comparably high pressures ($p > 25$ mbar). Further adjustments and tests are expected to substantially lower this threshold value.

ABOUT THE AUTHOR: David LEISER



David Leiser is a 25-year-old Ph.D. student at the University of Stuttgart working in the field of break up analysis. He grew up in Heidelberg Germany and New York USA before studying Aerospace and Aeronautical Engineering in Stuttgart Germany. This article was created as a part of his master's thesis in the High Enthalpy Flow Diagnostics Group (HEFDiG) of the Institute of Space System under the supervision of Arne Meindl and Dr. Stefan Löhle.



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Abbreviations

AS	Affiliated Society
WG	Working Group
AMEAC	Annual Meeting of the EUROAVIA Congress
IB	International Board
PAS	Prospective Affiliated Society



AS Aachen	AS Ankara	AS Athens	AS Berlin
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