

# Workshop Proceedings

1<sup>st</sup> European Workshop To Promote  
**Nature-Based Solutions**  
For **Aeronautics**  
And **Space Applications**

The living to  
lift-off innovation



Tuesday

**01 DECEMBER**

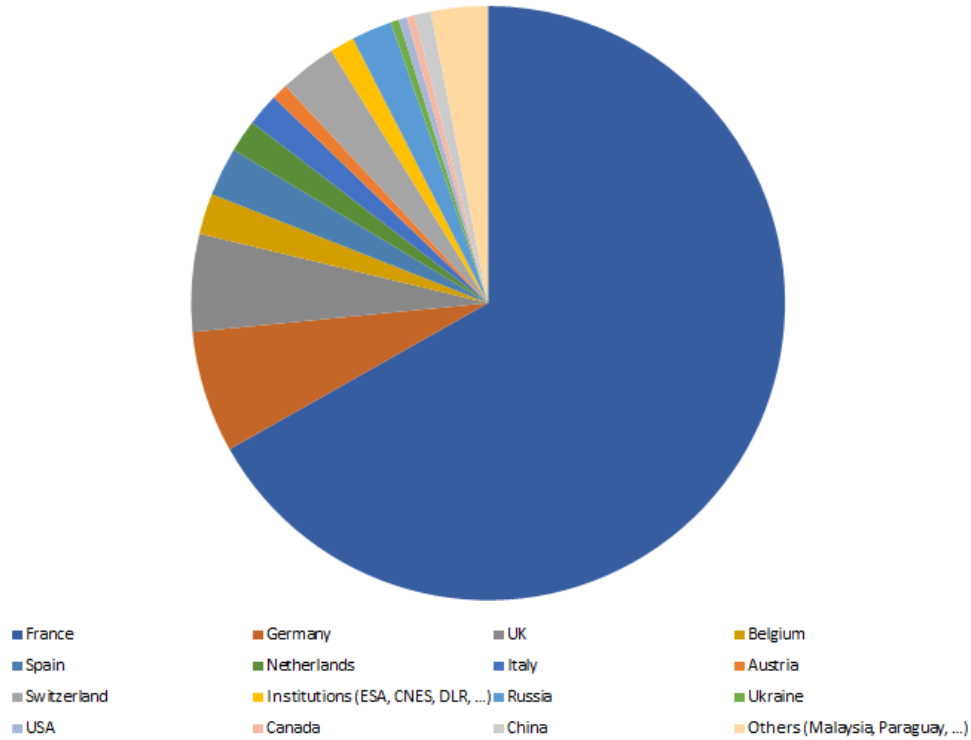
9:30 AM – 12:30 PM

**2020**

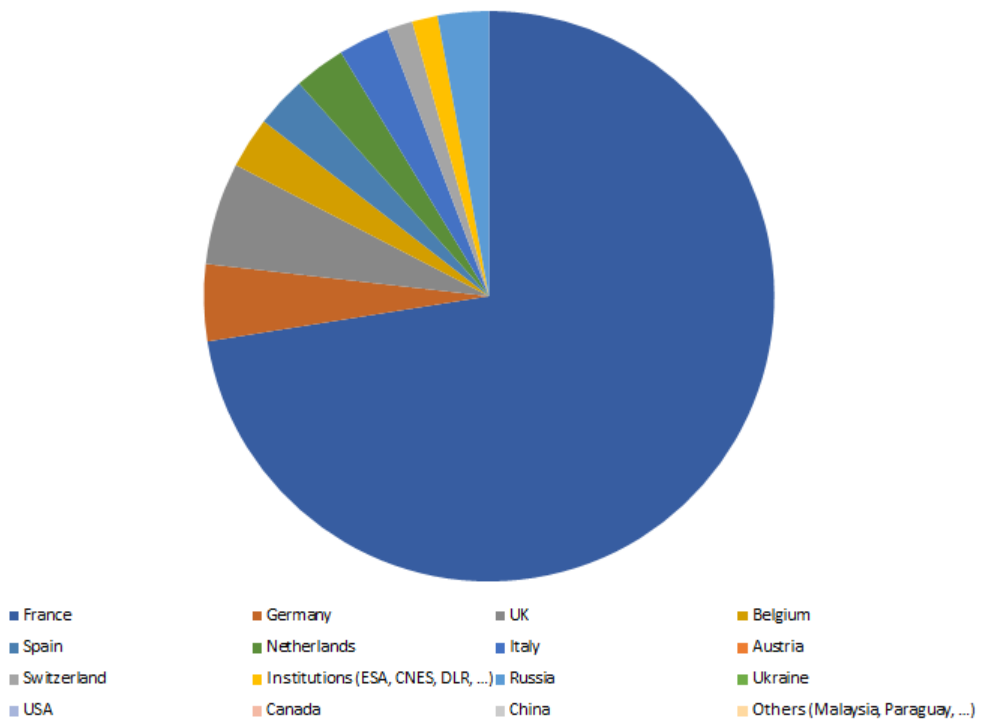


**1- The main figures of the workshop :**

- ✓ About 75 attendees (among 230 registered persons with ~35% of effective participation)
- ✓ Wide range of countries (more than 16) with ~95% coming from European countries and where circa 2/3 from France:

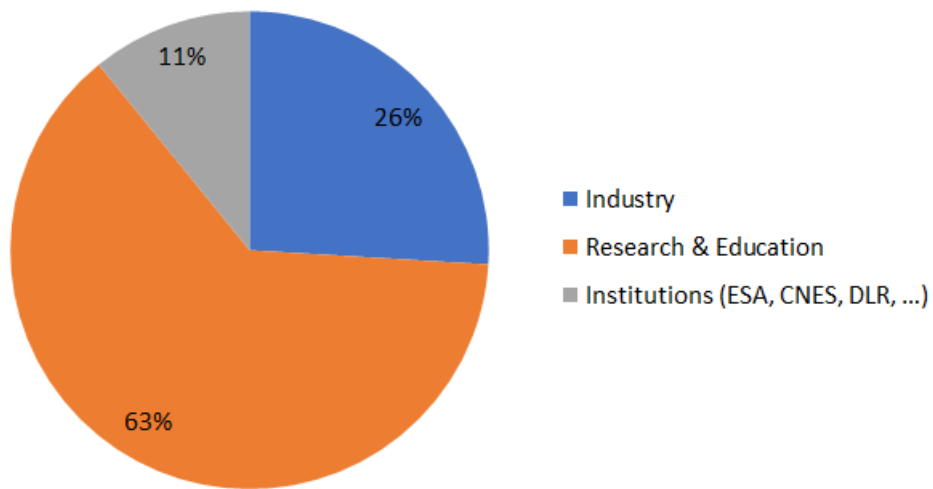


Distribution of registered vs countries

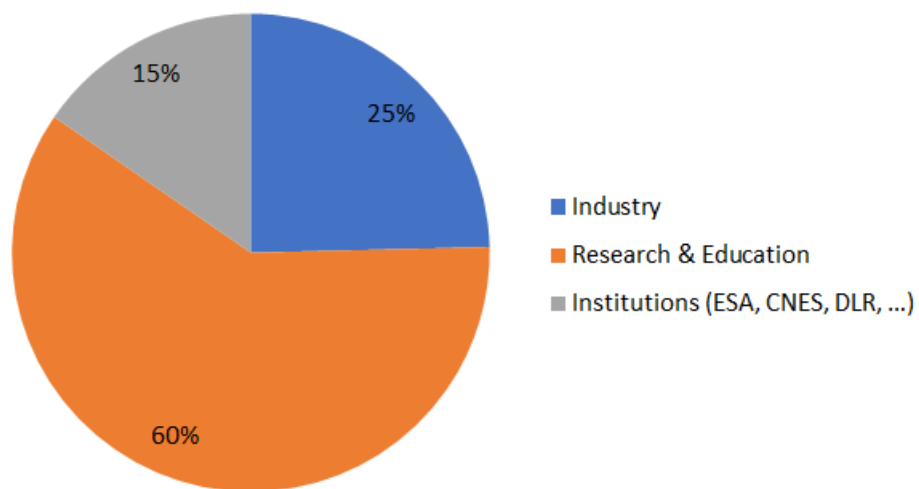


Distribution of participants vs countries

✓ Research & education very well represented:



Distribution of registered representatives



Distribution of participant representatives

## **2- Sum-up of the main messages:**

### Welcome messages by Michel FAUP (CNES):

CNES is pleased to welcome you for the first EUCASS workshop devoted to Nature based solutions in the field of aeronautics and space.

Contact between CNES and Ceebios was initiated in 2018 with the aim to analyse the interest of such approaches for space actors. During the past years we went through a rather traditional path: acculturation and pilot actions. At the present stage, it is obvious that benefit may be found in plenty of applications at the level of materials or elementary functions.

However, the main benefit could be at system level. Indeed, the space sector is undergoing a quick and strong transformation due to the numerical transition. This will imply that space actors become able to cope with a strong level of complexity where the traditional and efficient way to handle system issues was to simplify and split the system into individual uncorrelated functionalities. Both space and biological systems need to find a compromise to achieve resiliency, frugality, and performance.

Engineers have a lot to learn from nature. It is probably still a long way until such a step may be achieved but this workshop is a first step.

### Global overview and stakes by Cédric DUPONT (Air Liquide / EUCASS):

The objectives of this workshop are:

- to set up a forum on Nature-Based Solutions (NBS) dedicated to aeronautics and space,
- to bring together expertise of engineers and biologists, and
- to promote the interest of NBS to engineers and stakeholders with the possibility to implement short-term actions.

This workshop is co-organized by EUCASS. EUCASS (the European Conference for Aeronautics and Space Sciences) was created by European scientists and engineers in 2005 to improve the vitality of their scientific communication, the quality of their technical activities and to stimulate exchanges between researchers and industry end-users worldwide. It is an International non-profit association under Belgian law, member of the International Astronautical Federation. EUCASS aims is to provide a unique and attractive forum for all aerospace research players on the European continent through the EUCASS conference (even-numbered years) and workshops (odd-numbered years)

The next conference EUCASS-3AF 2021 will be held at Lille Grand Palais (France) from July 4<sup>th</sup> to July 9<sup>th</sup>, 2021. Abstracts on Biomimicry and Bio-inspiration are highly welcome!

[www.eucass-3AF-2021.eu](http://www.eucass-3AF-2021.eu)

Biomimicry introduction, context and methodologies by Kalina RASKIN (Ceebios):

Biomimetics is not new. It has been practiced for many decades by institutions and companies. We see lately a significant increase in the scientific production about bio-inspiration. There are new tools and techniques which enable us to compile more and more biological data and enable us to reproduce biological features, such as 3D-printing.

ICT, engineering, chemistry, and materials are the most active fields of biomimetics. The US and China mainly contribute to the scientific articles production but all European countries account for almost 40% of international research efforts. In all university there are bio-inspiration initiatives, particularly in Germany and Switzerland where millions have already been invested.

There are plenty of bio-inspired products on the market today. The aerospace sector and nature have a historical link and as for future opportunities, we can identify the topics of 'Features of life in extreme environments', 'inhabited structures' (e.g. Resource management by living organisms) and 'functional properties of biological structures' (specifically bio-inspired materials) as specific thematic for potential biology-to-engineering transposition. ACT (Advanced Concept Team) at ESA has already a vast background with bio-inspired projects and NASA last project on bio inspiration is to develop an automated tool to access biological data for innovation purposes.

Biomimetics as an innovation methodology is not new. It is increasingly practiced but it is not as easy as putting engineers and biologists together around the table. Several hurdles remain such as implementing pluridisciplinarity: training and culture background is still an issue to overcome that slows the innovation process. From experience, we have learnt that adding a creative profile in the process, such as designers, helps building this bridge between skills and fields. An another critical step is to access biological data which is still scattered and often not available with the right kind of analysis. However, the formalization of the biomimetics methodology as a tool for internal management of innovation was proposed a few years ago by Pierre Emmanuel Fayemi and Ceebios and all its partners are continuously working on improving the process with the feedback on concrete industrial projects.

Key challenges for Aeronautics and Space by Philippe TATRY (Airbus DS / EUCASS) :

Bio-inspiration is pushing us to tentatively identify a list of key-challenges that we have to face on aeronautics & space in order to assess some *valuable* potential bio-inspiration. Because of flying machines (e.g. aircraft, launcher, satellite) are very complex machines to design and to operate, there are many key-challenges; among them:

- ✓ "Driver-challenges" : Safety, performances, security, environmental objectives, economical equations, ...
- ✓ "Enabler-challenges" such as **(i)** large cooperation of actors vs countries, companies, research centers, institutions, etc **(ii)** manufacturing capabilities **(iii)** way of working all together **(iv)** ...
- ✓ "*Technical-challenges*" : for this 1<sup>st</sup> workshop on NBS, the emphasis is put on this kind of challenges

In this perspective, the addressed technical key-challenges are split into four types : **(i) systems** (e.g. batteries, generators, pumps, harnesses, computers, software, man-machine-interfaces, antennas) **(ii) structures** (e.g. primary & secondary including the associated materials and design rules) **(iii) thermics** (vs temperature range and cycling, etc) **(iv) mechanisms** (from big ones on aircraft landing gears or on ground/launcher interfaces up to the very delicate ones on satellites (e.g. on solar panel deployment, on optical instruments).

Obviously:

- ✓ The perimeter of each type (systems, structures, ...) depends on a lot of features. For instance, the perimeter of systems is not exactly the same on an aircraft and on a satellite: it is a question of flying machine development *history*.
- ✓ There are strong *dependencies & interactions*, for example :
  - On an engine, the thermo-mechanical difficulties address both structures and thermics skills & products.
  - To move the mechanisms, some sets of actuators & sensors are needed and they are part of systems.
- ✓ Consequently, a *systemic approach* has to be used to be efficient.

During this workshop, about *40 technical key-challenges* have been presented on systems (vs energy, data, systems of systems, ...), structures (vs materials, shapes, dampers, surface properties, monitoring, ...), thermics (vs temperature range & cycling, heat exchanges, insulation, ...) and mechanisms (vs deployment, micro-motions, gluing, ...) which are part of aircraft and spacecraft.

#### Opportunity review from biology by Luce-Marie PETIT (Ceebios) :

The previous presentation expressed the technical challenges that might be addressed by the bio-inspiration approach. At first glance, due to the pluridisciplinarity of the approach, it is not clear which biological model would help to solve the issues in Aeronautics and Space. That is why it is necessary to transpose the technical requirements into biological and environmental constraints before talking to biologists.

For each challenge, an overview of biological models has been presented. The goal is to extract relevant design principles that can be applied in Aeronautics and Space and go beyond individual examples to explore living organisms in a more transversal approach.

During this workshop, about *40 biological models and examples of biomimetic applied projects* have been presented on systems, structures, thermics and mechanisms, among which:

- ✓ Artificial photosynthesis, mimicking the natural process of photosynthesis (conversion of solar energy and water into organic compounds) based on local and recyclable chemical compounds). It provides new possibilities for clean hydrogen production.
- ✓ Neuromorphic chips, inspired by the brain functioning, can enable fast, low energy computing with real-time learning.
- ✓ Sol-gel chemistry reproduces the glass making process of diatoms and marine sponges in water, in ambient conditions.
- ✓ Swarm behaviours within colonies of social insects or shoals of fish which emerge from many individual autonomous agents.
- ✓ Low weight, strong and stiff materials like bamboo stems, bone, abalone shell, insect cuticles
- ✓ Multifunctional properties of biological surfaces: superhydrophobic plant leaves, antifouling shark skin, anti-icing insect eyes, antimicrobial cicada wings ...
- ✓ Efficient heat exchangers of elephant ears, nasal cavity, animal legs ...
- ✓ Deployable structures like ladybird wings, chameleon's tongue, seed dispersal mechanisms ...
- ✓ Gluing mechanisms of geckos feet, mussels on rocks, climbing plants like the English ivy ...

Bio-inspired projects - Drilling Micromechanisms and Cryotechnic Flying Wing by Yves GOURINAT (ISAE-SUPAERO) :

A set of examples of biomimetics applications have been presented and illustrated:

- ✓ Space drilling micro-mechanisms: by inspiring on wood wasp drilling technique (i.e. with low reaction & power),
- ✓ some applications exist on brain cavity surgery,
- ✓ Flying wing as studied by Northrop in the 50's inspires contemporary cryotechnic applications with optimization of materials & internal arrangement
- ✓ Design of launcher by using frugal methods to optimize the boundary elements for solids (i.e. to save the weight & computing power)
- ✓ Aircraft shape inspired by birds (in cruise, landing, ... phases) including fly-by-wire active control on flexible structures
- ✓ Composite structures (A350 wings, Space Shuttle tanks, ...) inspired from honeycomb & isolating biomaterials.

Bio-inspired projects - Towards a sustainable aerial mobility inspired by nature by Erwin GOWREE (ISAE-SUPAERO) :

It is undoubtable that in order to reduce our current impact on the climate the greenhouse gas emissions from transportation and the energy sector should be cut down drastically. The most simplistic way will be to reduce transportation and consumption significantly, as recently seen during the nationwide lockdowns due to the Covid-19 pandemic; however, this came at great economic cost which we cannot afford as a society based on our current life style. Mobility systems still rely heavily on fossil fuels and even with the rapid advances in battery technologies electric propulsion is still limited to ground mobility systems which can afford the relatively low power to mass ratio. Therefore, this brings us back to square one of our traditional design approach where efficiency and reduction of power consumption is at the heart of the design process. Hydrogen is also emerging as another cleaner alternative for fossil fuel however the power to volume ratio is slowing down its implementation, especially for aerial mobility. Hence, the reduction of power consumption becomes a priority in the design process even for these carbon free technologies. In order to revisit the need for reducing the power consumption of mobility systems here we aim to adopt a completely different approach inspired by nature, where the living can engage into complex kinematics through minimal energy intake. The concepts in nature are always looking for the best return in terms of the energy input/consumed and work-done, therefore this approach will naturally lead to a highly optimal system which consumes the least and contributes positively towards our goal of achieving a sustainable aerial mobility system. Here, techniques for aerodynamic drag reduction and manoeuvrability enhancement will be reviewed alongside the equivalent concepts that already exist in nature.

### Bio-inspired projects - Microsensors inspired by insect sensory systems by Julian VINCENT (Heriot-Watt University Edinburgh) :

My interests are governed by a fascination with biology; more specifically with insects and their relatives, such as spiders and crabs. This comes from parallel interest in engineering, since a large part of the workings of these beasts is literally on the outside in the form of an exoskeleton or cuticle. All information has to be generated by, or pass through, this protective and supportive layer, which therefore has to have a balance of properties, some of which seem to be mutually exclusive (Vincent, 2005). One of these functions is mechanical sensing, picking up sounds, touching and loads. In a stiff skeleton this implies compliance so that the mechanical stimuli can generate sufficient displacement to be sensed by a cell. One way of increasing compliance is to introduce holes in the exoskeleton and measure their deformation. In insects these are campaniform sensilla; in spiders (Arachnida) they are slit sensilla.

#### **Campaniform sensilla**

In section a campaniform sensillum is composed of a stiff dome or cap suspended in a thin membrane of cuticle which effectively covers the hole. As the hole is deformed the cap moves up and down, stimulating a sensory cell attached to the underside of the dome. The hole is surrounded by a stiff collar that probably helps protect the hole from fracture (Grünert and Gnatzy, 1987). Movement of the cap in and out is a linear function of the deformation of the hole, so the overall function is to rotate the strain in the cuticle by 90 degrees so that it can be sensed beneath the cuticle (Skordos et al., 2002).

From the outside, the sensilla appear as oval dimples. They tend to occur in groups with the long axis of the dimples parallel. This implies that they deform in response to the direction of the applied strain as well as its magnitude (Zill and Moran, 1981). Thus their function is analogous to a strain gauge. Positioning of the sensilla tends to be where deflection is likely to be the greatest, thus increasing sensitivity.

The campaniform sensillum was imitated in silicon at Delft University (Wicaksono, 2006) where, amongst the methods used to measure deflection of the cap, laser ranging was found to work well. This suggests that the campaniform sensillum design would work as a totally isolated device, perhaps a formed tab adhered to a surface, that could be remotely interrogated.

#### **Slit sensillum**

Compliance can also be introduced in the shape of slits in the cuticle. Since these have a high aspect ratio and can easily be nested alongside each other, and are also sensitive to different frequencies, they make excellent vibration sensors, which explains why they are such a characteristic feature of spiders that hunt detecting slight vibrational changes in their environment (Barth et al., 1984). It's almost impossible to make physical models of such arrays, but the discovery that slits developed by carefully fracturing a thin layer of metal laid down on an elastic polymer were just as good crack-based (Kang et al., 2014; Liu et al., 2021) has generated a lot of interest in a nano sensor that can be mounted anywhere as a patch. Such slits are highly sensitive and discriminatory, producing clear signals in the presence of noise that confuses a conventional microphone. The vibrations reaching the slits can be filtered selectively by their surroundings. In *Cupiennius salei* a sensor on the leg receives vibrations from the adjacent segment. A viscoelastic cap between the two segments filters out the high frequencies when the two segments are pressed together, compressing the cap. Thus the slit is transformed into a quasistatic load receptor like the campaniform sensillum (Barth, 2002; Erko et al., 2015)

### ESA initiatives in bio-inspiration and feedback by Leopold SUMMERER and Thomas VASILEIOU (ESA)

The Advanced Concepts Team (ACT) of ESA consists of a multidisciplinary group of scientists that monitor and perform research on state-of-the-art concepts and technologies. Natural organisms and biological processes have provided the team with several ideas, since the creation of ACT. Several past biomimetic projects are reviewed in this presentation: from energy conversion imitating photosynthesis to chemical sensors using as active component the spider web silk, and dispersal techniques replicating the dandelion flower mechanism. Moreover, an ongoing project is discussed further: the light absorption enhancement for space solar cells using nano-patterns replicated from nature.



“Klaxoon” interactive sessions with participants :

A sum-up of the Klaxoon sessions is provided in appendix.

And Beyond ? by Stephan HOORNAERT (Morpho-Biomimicry) :

Welcome in 2030. Remember 2020! Our civilization was going through the Covid-19 crisis. It was a major crisis. A single coronavirus deeply shocked the entire system, which almost collapsed. Fortunately, we were able to identify the reasons for our weaknesses and adapt intelligently. In order to ensure the continuation of life on earth, we have evolved our beliefs. From our deadly economic system to a regenerative economic system, from mineral and barren cities, to autonomous and resilient cities, our ways of thinking have had to change profoundly. Some key points for progress have been identified and among these:

- ✓ Reconnecting with our own internal ecology,
- ✓ Learning to work together in an interdisciplinary way
- ✓ Understanding the complexity of the eco-systemic approach
- ✓ Being inspired by the genius of Nature

Thanks to these paradigm shifts in our ways of thinking and being. We have been able to develop new concepts from micro to macro: new transportation systems (the Mobot being only one example) but also regenerate our cities and territories to make them autonomous and resilient. By doing this, we did evolve from an endangered species to a multi-planetary species.

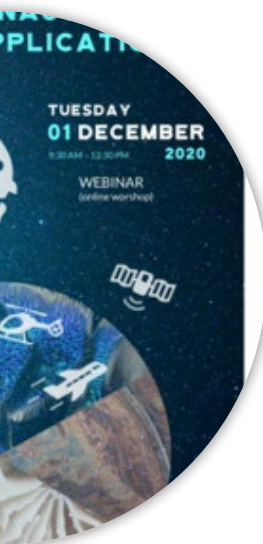
**3- Conclusions and perspectives:**

Potentially:

- ✓ Prepare a 2nd edition of the workshop with physical attendance to facilitate discussions and debates
- ✓ Create a newsletter
- ✓ Build a networking platform
- ✓ Develop a sectorial strategy in bio-inspiration (e.g. with a regular working group)
- ✓ Initiate collaborative/interdisciplinary R&D projects
- ✓ ...

The next EUCASS-3AF Conference takes place in Lille from 4<sup>th</sup> July to 9<sup>th</sup> July.

**Abstracts on Biomimicry and Bio-inspiration are highly welcome!**



## Report

# 1st Workshop on Nature-based Solutions for Aeronautics and Space Applications

Meeting hosted by Cedric Dupont



## Table of contents



Report



Activities



Presentation



Messages



# Report



## 1st Workshop on Nature-based Solutions for Aeronautics and Space Applications















Nov 25, 2020

hosted by Cedric Dupont

Welcome to the interactive sessions of the 1st European Workshop to promote Nature-based Solutions for Aeronautics and Space Applications!

## Activities

-  General interests on nature based solutions 2 questions
-  Technical interests nature based solutions 3 questions
-  Brainstorming session 1 42 ideas posted
-  Brainstorming Session 2 23 ideas posted
-  Next steps for 2021 workshop 6 questions
-  Could you evaluate if this Workshop allowed you to discover... 16 /74 votes
-  Could you evaluate if this Workshop allowed you to better k... 16 /74 votes
-  Could you indicate if this Workshop allowed you to: want to ... 14 /74 votes
-  Could you evaluate if this Workshop allowed you to motivat... 15 /74 votes
-  Have you already NBS subjects to be presented during Euc... 11 /74 votes
-  Will you participate to the next workshop in person that will ... 16 /74 votes
-  As last question, is this workshop a good initiative ? and wo... 18 /74 votes



## General interests on nature based solutions

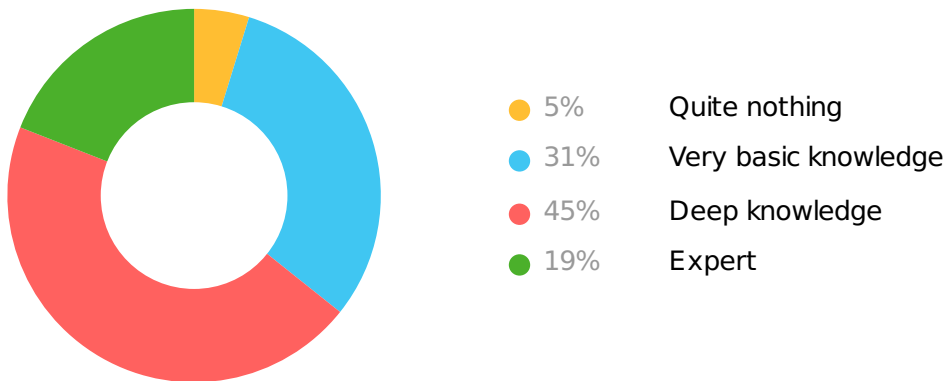
Number of participants	42
Number of questions	2

Question 1

What is your level of knowledge on biomimicry?

single choice

4 choices



Question 2

What is, by order of importance, your interests in bio-inspiration?

ranking

4 items

- 1 A new methodology of innovation
- 2 to reach sustainability
- 3 multifunctionality tool of pluridisciplinarity
- 4 breakthrough objective



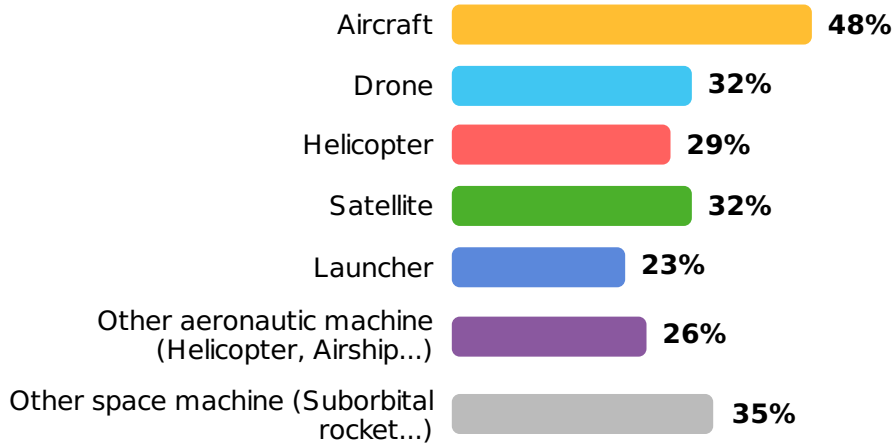
## Technical interests nature based solutions

Number of participants	43
Number of questions	3

Question 1

On what kind(s) of flying machine are you involved?

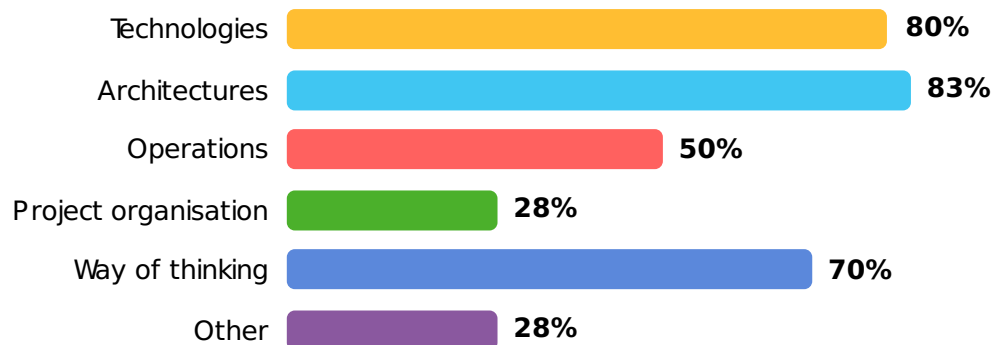
multiple choice 7 choices



Question 2

On what field(s) do you imagine that biomimetics benefits could be very significant?

multiple choice 6 choices



Question 3

If we focus on engineering design, on what fields do you think biomimicry could be very significant?

ranking

7 items

1

Materials

2

Structures

3

Systems

4

Mechanisms

5

Thermics

6

Propulsion

7

Avionics





# Brainstorming session 1

Number of participants

22

Number of ideas

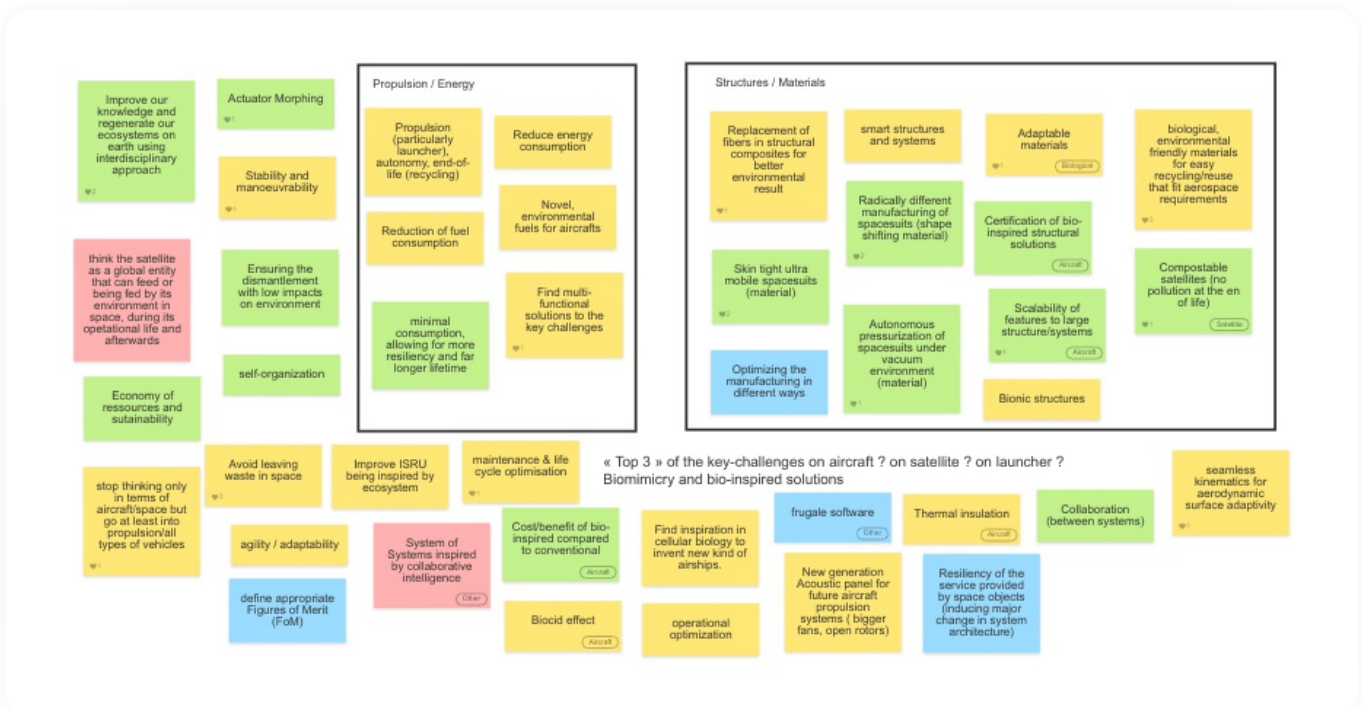
42



« Top 3 » of the key-challenges on aircraft ? on satellite ? on launcher ?  
Biomimicry and bio-inspired solutions

Board

screenshot





## Brainstorming Session 2

Number of participants

15

Number of ideas

23

New topics to be addressed for the next workshop

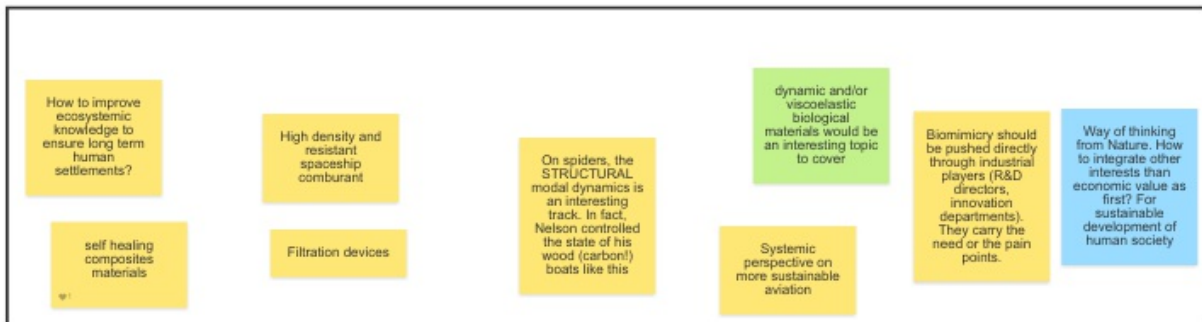
Are you aware of initiatives in your country (network, call for projects, funding opportunity)?



For project organisation, way of thinking, ... do you have in mind some suggestions to use biomimicry in order to significantly improve them ?

Board

screenshot



New topics to be addressed for the next workshop

Are you aware of initiatives in your country (network, call for projects, funding opportunity)?

For project organisation, way of thinking, ... do you have in mind some suggestions to use biomimicry in order to significantly improve them ?





## Next steps for 2021 workshop

Number of participants	30
Number of questions	6

### Question 1

What would be the next steps in your view (e.g. a working group, some specific project(s) to be launched, ...)?

open ended question

#### **m d**

small, multi-disciplinary discussion groups on focused topics - brainstorming engineering challenges + biological examples and solutions

#### **NF**

Group work!

#### **Christophe Surdieux**

Maybe Organize working group, but i'm interested in everything so it is difficult

#### **Martin**

working group and exchange platform

#### **MBu**

Working group

#### **Stephan H.**

WG on creation of ecosystems to ensure long term human settlements and regenerate our planet

#### **Maxime G**

Getting sponsorship from R&T executives of big actors: Airbus, Ariane , CNES .... In order to have funded projects

#### **David CLECH**

Create some working group to launch collaborative projets on dedicated topics Create some specific digital tool to exchange scientific data and cross research on one specy

#### **Ale-Bianciardi**

Working groups connected in dialogue so to explore sinergies among solutions to problems (multi-functionality of solutions) Project on exploring Terraforming strategies (how to live on another planet)? That would be very useful also to solve problems on our Planet!

#### **Accio**

Small rotating working groups with expert tutoring ?

#### **Casas**

join forces with already existing groups. You are a very new newcomer

#### **Eliav Haskal**

Materials working group with industrial partners

#### **FishDrone**

Legitimize the bio-inspiration to the point of being a real and strong branch in engineering

**BR**

WG on specific items (technical items with space and aerospace actors) Collaborative Project building on main 3 topics

---

**Elsa**

concrete projects

---

**Ugo LA font (ESA)**

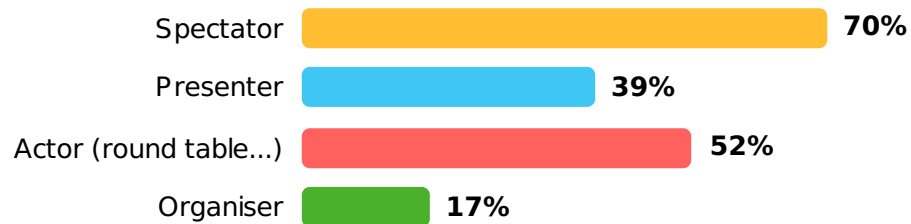
Working group indeed including space agency

Question 2

What would be your level of involvement in the next steps?

multiple choice

4 choices



Question 3

Is this workshop a good initiative ? and would you recommend or promote it ?

open ended question

**m d**

yes, it's great - I'd like to hear more talks, perhaps short, paired talks between engineers+biologists (i.e. each gives 10mins on the same theme)

---

**Christophe Surdieux**

YES YES YES

---

**Martin**

Yes :)

---

**MBu**

Yes very good initiative : many thanks to organizers and presenters!

---

**Stephan H.**

Of course ^^

---

**Maxime G**

Very good initiative. Yes I recommend

---

**George**

Absolutely

---

**David CLECH**

Yes. We need to increase the links between the different actors in France to go ahead. A global french working group will be interesting to improve the coordination of all the actors in France and develop innovation, business and science.

---

**Ale-Bianciardi**

Absolutely! Thanks a lot for this!

**LorenzaPacini**

Yes, great initiative. I am available to promote it at an academic level (for example, in my doctoral school (<https://edeea.universite-lyon.fr/> )

**Angelo Vermeulen**

Absolutely. There's not enough public consciousness about the field of bio-inspired engineering and its recent advancements. Also, the connection with aerospace is really crucial for the future of space exploration concepts and technologies.

**Accio**

Yup

**R. Günther**

Yes, definitely a good platform and I'll promote it. I'm hoping that personal exchange and discussions can take place next year.

**Roxane**

A good initiative and I would recommend it

**FishDrone**

Great experience, I would love to assist and maybe participate in several occasions like this one, thank you very much for the invite

**BR**

Yes really good initiative!

**Elsa**

yes more information like an abstract review would have been interesting

**Ugo LA font (ESA)**

definitely

**jorge**

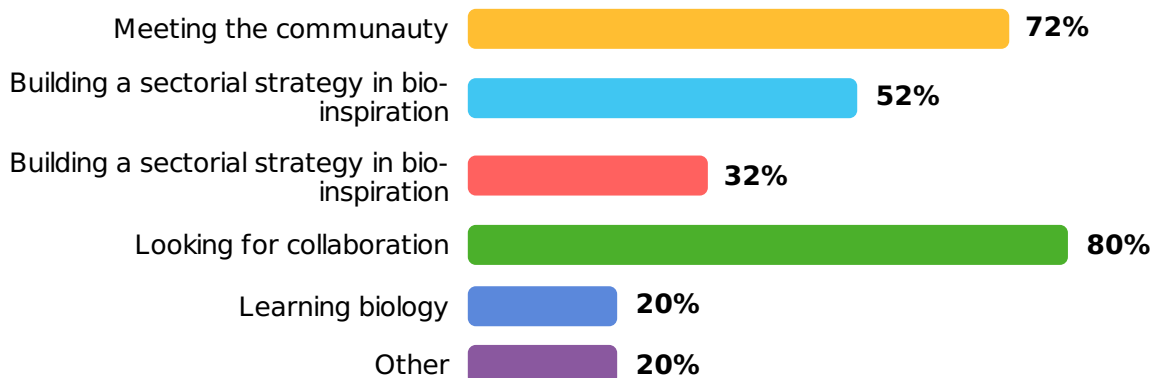
Definitely yes, and I would promote it.

Question 4

What should be the main objectives of the 2021 workshop?

multiple choice

6 choices

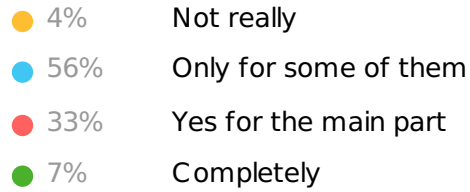
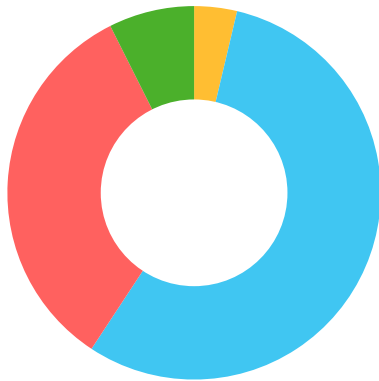


Question 5

Were you aware of such kinds of application examples?

single choice

4 choices



Question 6

Other ideas

open ended question

**m d**

...how can 'biomimicry' truly work as a collaboration and not just a buzzword? :)

**Christophe Surdieux**

Maybe capitalize on what can be shared between domains (material portfolio, sensors portfolio...)

**Stephan H.**

Thanks

**Maxime G**

I am planning a workshop with CEEBIOS in december to apply methodology on acoustic panels. I could present the outcomes.



Could you evaluate if this Workshop allowed you to discover the large range of biomimetics benefits?

live vote

rating



**4.4**  
group average

**16** /74 votes



Could you evaluate if this Workshop allowed you to better know their potentialities?

live vote rating



**4.1**  
group average

**16** /74 votes





Could you indicate if this Workshop allowed you to: want to be involved in the next steps ?

live vote

rating



**3.8**  
group average

**14** /74 votes



Could you evaluate if this Workshop allowed you to motivate you to go further ?

live vote

rating



**4.1**  
group average

**15** /74 votes



Have you already NBS subjects to be presented during Eucass conference in July 2021?

live vote

yes - no

yes  
45%



5 votes

no  
55%



6 votes

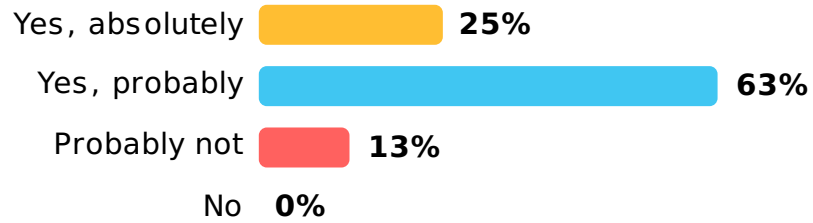
11 /74 votes



Will you participate to the next workshop in person that will be held in Paris in 2021?

live vote

choice list



16 /74 votes



As last question, is this workshop a good initiative ? and would you recommend or promote it

live vote

rating



**4.8**  
group average

**18** /74 votes



# Presentations

Number of presentations

2



Coffee Break (Videos)

1 page

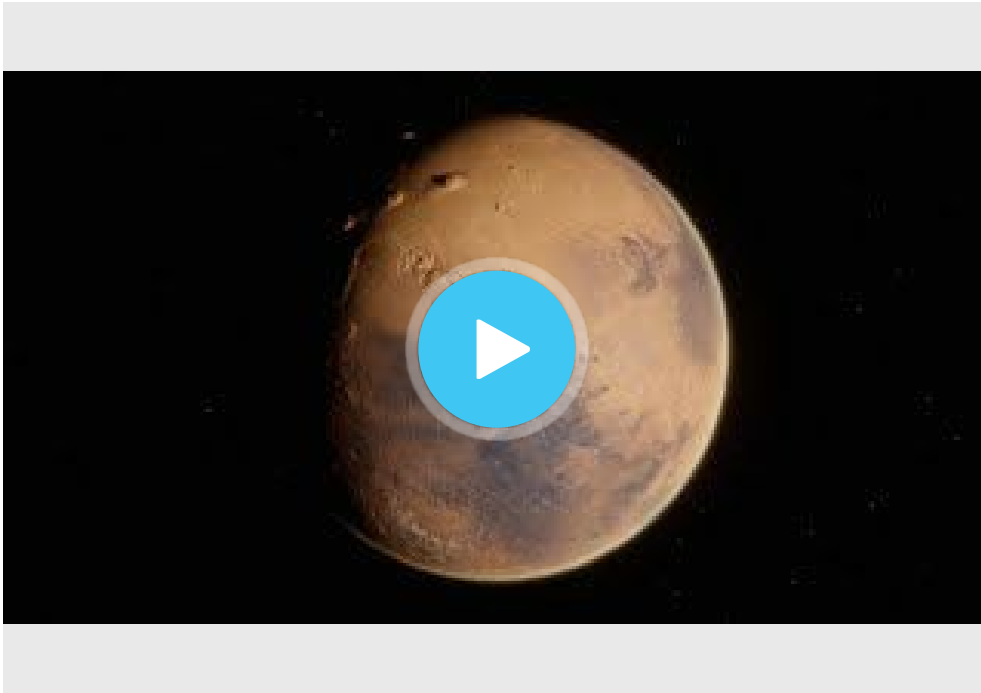


Thank you

1 page



Page 1



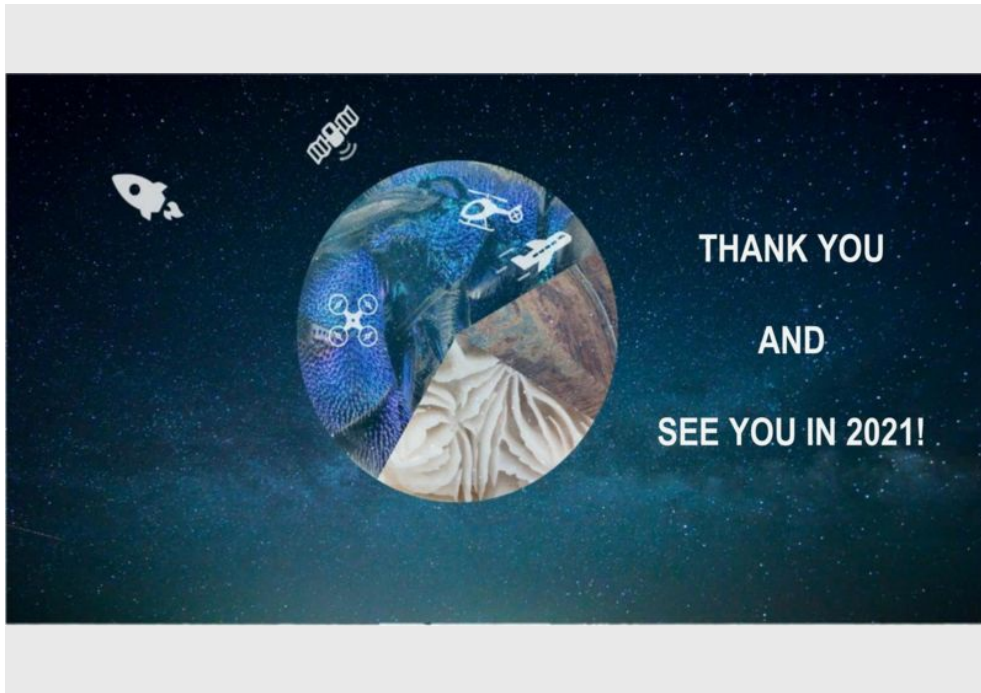
Nature = Futur !



# Thank you

1 page

Page 1








# Messages

Number of messages

1

**terrespace** *Dec 1, 2020, 19:37:11*

Bravo à tous pour la qualité des présentations. Quand pensez vous mettre les planches à disposition pour téléchargement ?



**Benjamin F.** *3 centuries ago*

Tell me and I forget, teach me and I may remember,  
engage me and I learn.

**Klaxoon** *today*

Thank you for your participation.

Want to know more?  
+33 (0)2 22 74 06 70  
[help@klaxoon.com](mailto:help@klaxoon.com)



## ✓ **Appreciated**

- From Airbus participants : *“Eclectic” ... “Both high level and with application cases” ... “Anticipation case, pretty innovative” ... “Very interesting topic, not seen very often in conferences, providing a different perspective and way to approach new problems” ... “Lot of different examples with real applications. Loved it !” ...*
- From others : *“Structure of the presentations (i.e. needs → biological possibilities → examples)” ... “Interactions with public” ...*

## ✓ **Room of improvement**

- From Airbus participants : *“None” ... “We see the original idea in nature and the final implementation, but we usually miss the process in between” ... “It would be helpful for people looking for a methodology to get to this type of solution (otherwise it looks like chance or serendipity)” ... “More diversity vs countries” ...*
- From others : *“To include more answers related to environmental and energy issues (materials scarcity included)” ...*

## ✓ **Goodwilling/involvement to boost/promote the biomimetics**

- From Airbus participants : *“To contact Geotrend (Toulouse start-up)” ... “Happy to help, support and spread the word !” ... “In the current times, it needs to also send the message about respecting the environment, learn from the biodiversity and also taking care” ...*
- From others : *“To study the possibility to develop and support an action with aerospace sector in Occitanie (e.g. thanks to ADEME / CEEBIOS program)” ...*

