

[N]avi[g]ator

WS 23/24

Launch into your university life

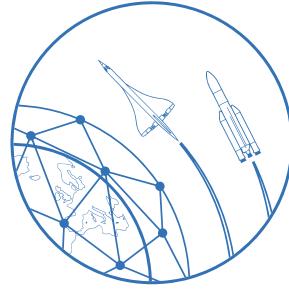
Read the guide through your first semester, with tips and tricks from fellow students and professors. - page 5



Have you ever wondered how it is to be a PhD student, engineer, tutor and surfer?

Find it out in the **exclusive interview** with **Jon!** - page 17

EDITORIAL



Dear beloved readers,

Once again, welcome back to the hallowed halls of TUM, or perhaps I should say, welcome back to the Tentomax. Are you guys and girls ready to get started with a new and exciting semester? Do you finally think that you're prepared for everything that TUM has to offer?

To our senior students, I sincerely hope you had a relaxing summer break or at least enjoyed what remained of it after the never-ending exam phase. Every time I finish another exam phase, I'm left with a sense of emptiness. My go to after studying six weeks straight is first of all a little party (as my friends would say: "Die Festplatte neu formatieren"), after that I either go on a nice trip or start binge watching Netflix and enjoying the last rays of suns with a good book. Hopefully you also have a good tradition after such an exhausting time.

A warm welcome to all the newcomers at TUM! We're happy to have you here and introduce you to our Student Council Magazine "[N]avi[g]ator". This bi-yearly magazine is catered to every student in our faculty. We cover anything Aerospace and Geodesy related from the latest happening in the industry and research, to more relaxed lifestyle spreads such as films and crosswords.

I know a lot of things are going to be new, exciting and maybe also a little overwhelming - meeting new people, relocating to another city far from home or just the realization that university life may not match your initial expectations - rest assured you are not alone. The simplest way to overcome all of this is to find yourself new friends and enjoy this new part of your life. Before sending out this [N]avi[g]ator, I want to thank some people. Firstly, thank you to all our sponsors. Without their continued support, we wouldn't be able to print and freely distribute this magazine. Secondly, I want to thank all those who submitted ideas or assisted us with articles. Special thanks to **Professor Werner** for contributing the article on AI in Aerospace and Geodesy and **Jon** who made it possible for us to get to know him better. Last but not least, I want to thank **Daniel** and **Shanti** for their articles, creative input, constructive criticism and above all, unwavering belief in this process. Without you I would be standing here all alone with a bunch of ideas and nothing in hand to present ♥

Now I'll shut up and let you enjoy the new edition. Wish you all the best this winter semester.

Sabrina Wirth
Chief Editor "[N]avi[g]ator"

P.S.: If you have any ideas, suggestions or critics come join us or send us an E-mail via pr.fslrg@ed.tum.de.

Content

Legal Notice



WS23/24

V.I.S.D.P.

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Important Informations

Winterterm 2023/24: 01.10.2023 – 31.03.2024

Lectureperiod: 16.10.2023 – 09.02.2024

Semester break: 01.10.2023 – 15.10.2023

10.02.2024 – 31.03.2024

Lecture- free time: 24.12.2023 – 06.01.2024

28.03.2024 – 01.04.2024

Payment deadline: 15.02.2024

Summerterm 2024: 01.04.2024 – 30.09.2024

Lectureperiod: 15.04.2024 – 19.07.2024

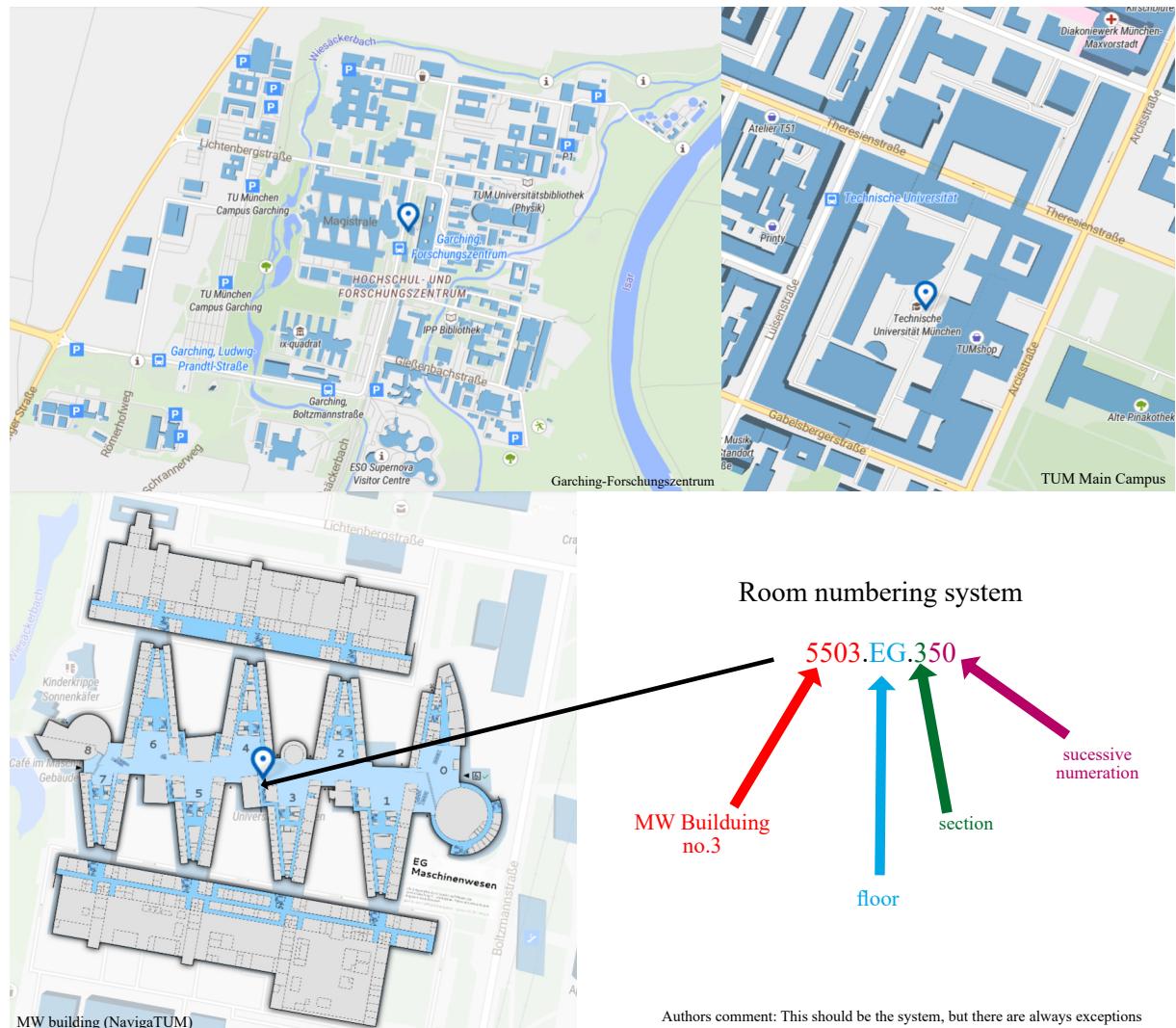
Semester break: 01.04.2024 – 14.04.2024

20.07.2024 – 30.09.2024

Lecture- free time: 18.05.2024 – 21.05.2024

Payment deadline: 15.08.2024

Be aware that exams can also be scheduled in the semester break !



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What do we do?

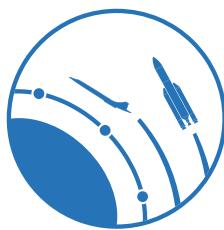
We represent you, the students! Our dedicated team works to ensure your voices are heard in various university committees. We're here to make your journey at TUM as smooth and enjoyable as possible.

What's in it for you?

Joining the Student Council will provide you with the opportunity to grow. We organize exciting events like the Takeoff-Week and the Christmas Party, discuss current study information, offer cool merchandise, and keep you informed with engaging media such as our magazine [N]avi[g]ator and our podcast "ON AIR - Actually Rocket Science." You'll find that there is plenty of room for you to take on responsibilities.

Get involved!

Your voice matters, and we want to hear it! Whether you have ideas to share, questions to ask, or simply wish to be a part of something great, our Student Council Meetings are open to you. We're thrilled to meet you and create an impact together!



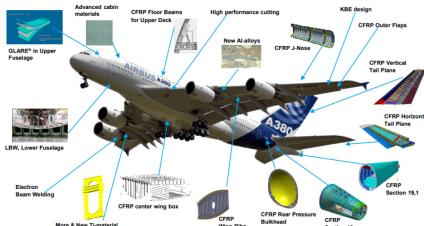
Student Council of Aerospace & Geodesy



My first Aerospace semester – an introduction to aerospace courses

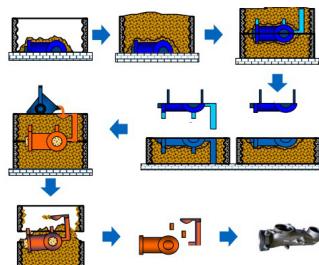
You are starting your studies at TUM and are not sure what to expect? You read the course descriptions, but want to have some insights of prior experiences with your first semester courses? The following might help you to get an initial idea of what you are dealing with. Written here, you will find a list of experiences and tips for each of your courses, including (unofficial!) information about the lectures and exam.

Aerospace Material Science and Processing:



This course will be by your side for two whole semesters and it's going to be a lot of content. The topic of materials and processing might be a little dry and it can be hard to focus during the lectures, but it is an 8 credits course and should be treated with the needed respect. When it comes to the content, it is often hard not to get lost in all the provided graphs, tables and information. Try to estimate what is the most important information and focus on this. Maybe read the intended learning outcomes at the start of the lecture slides. The course provides a general overview of material properties and processing techniques for common aerospace materials, like carbon fibre reinforced composites, aluminium, titan etc., without going too much into detail. As it is, even without the specific details, still a lot of content, it would be beneficial to start learning early enough, even though this can be hard, as you will have enough other stuff to do. It is of course possible to just learn all the information "brainlessly" by heart, but it can be beneficial to actually understand, where all the material properties are coming from and how they correlate. The examination isn't too hard

in terms of understanding and time management and it is a digital exam with usually mostly multiple choice questions or filling in gaps exercises, so it can be a good opportunity to get a good grade in an 8 credits course. "Digital exam" means you will sit in the examination hall with your own or a provided laptop and the exam will be done digitally on that laptop.



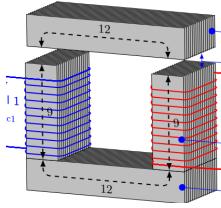
Electrical Engineering:

The electrical engineering course is very popular when it comes to pushing it into the next semester. It is designed over two semesters with one exam at the end of the second semester, which is often pushed away. This is due to the design of the course introducing a lot of topics in limited time, which makes it hard to grasp all the concepts. Pushing it away can be done, but I would not recommend it, since you will have to write 7 exams in one semester at some point or extend your study time. If you additionally fail one or two exams, this will only add up to a pile of due exams. So, it might be wise to at least give it a try. If you do so, you will have to try to keep up with the lecture and not get overwhelmed by the abstract

topics. Ask questions, do the exercises and maybe try to get your knowledge from external sources, if you really can't deal with the given explanations. As the course is of now, you will have to deal with the basics of DC (direct current) and AC (alternating current) circuits as well as electric and magnetic fields, semiconductors, power electronics, some knowledge about operational safety, one and three phase AC systems leading ultimately to rotating field machines and rotating field drives. Which is a lot. These topics are then split into knowledge based and more exercise focused ones. Meaning the distinction between just knowing things and actually using that knowledge. AC systems and rotating field drives as well as rotating field drives aren't trivial topics for unexperienced students and, due to the limited time during the two semesters, there is just not enough time to go into detail. This leads to an awkward mixture somewhere in between only knowing some basic facts and really understanding the processes and backgrounds of an electronic device. If you want to properly understand the topics, you would have to invest additional time. Time, that you do not have. So my personal advice would be to just accept the things how they are, without questioning the reasoning behind them in order to keep your sanity. Whenever you just go over a topic very shallow, you won't have to understand it in detail.



In the exam there will probably be a mixture between some knowledge questions and calculation exercises. The knowledge questions are not too much in detail and are often derived from the described shallow topics. The calculation exercises might include parts, where you need knowledge as well, and you will of course need to have understood the calculation topics to some degree. Calculation exercises are only about the exercise focused topics, which you can detect by checking whether or not there were homework tasks regarding that topic.



Computational Foundations I (CF I):

If you are amongst the people, who have no prior knowledge about programming, this course will probably confuse you at first. Especially the first lecture and first homework tasks might lead to frustration. But, if you take the time to understand the basics of C and later C++ programming, it will get better. Unfortunately, this highly depends on your motivation to actually learn programming. If you decide not to do the tasks given to you and give up on the course, then you most likely won't understand anything. The structure of the lecture itself can lead to further confusion, as it has been constantly in change throughout the last two years. Should this be the case for you, I would recommend reading the script. This is usually quite structured and detailed.

Additionally, it helps to have some time to process what is written there instead of just hearing it and then getting the next input right away. I however advise you not to give up on any lectures lightly and just sticking to the script instead, as it is often the fact of reading it again or hearing it again, that helps us understand the content of a lecture. In the end, the exams of CF I and CF II are usually on the easier side and with some decent preparation you can get a fairly good grade without working your fingers to the bone. You will have other subjects where that might be necessary.

And proving things yourself will be part of your examination, although last time it was not the biggest part. While trying to prove something we often are equipped with a certain set of tools, that are to be kept in mind. This being the easy part, the real difficulty of proofs usually comes from just having the right idea on how to prove something or not having this idea. Unfortunately, this just comes down to practice and experience. If you have encountered a certain number of problems then you will recognize them, sort them in a category in your mind and then remember the correct path to solution. So please attend the tutorials, do the exercises and ask questions to your tutors and fellow students.

This a highly important course as it is not only worth 8 credits but also one of your two GOP's (Grundlagen and Orientierungsprüfung). This means you will have to pass it within two tries until the end of the second semester. So please focus on this course with the addition of Engineering Mechanics I as your two top priorities. This doesn't mean to neglect the other courses completely but

Mathematische Grundlagen:

It is hard to give a completely course specific advice for this course, as the lecturer has switched and might switch again for your course. So here is something about the content in general. Depending on your prior education, some of the “mathematical structures” and “mathematical language” will probably be confusing to you at first. It needs some time to get used to it and it also will be difficult to get used to proofs, if you haven’t encountered them yet. As this is no longer school math, many things that would have been accepted as given in your prior teaching style will now require to be proven.

Laplace development of the determinant

Given $A \in \mathbb{R}^{m \times n}$, we denote by $A_{ij} \in \mathbb{R}^{(m-1) \times (n-1)}$ the matrix obtained from A by erasing row i and column j .

$A_{ij}:$ ()

the following formula holds true:

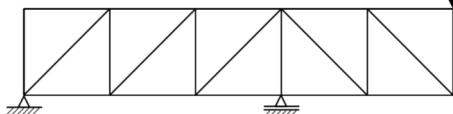
$$\det(A) = \sum_{i=1}^m (-1)^{i+j} \cdot a_{ij} \cdot \det(A_{ij}) \quad \text{development}$$

$$\det(A) = \sum_{j=1}^n (-1)^{i+j} \cdot a_{ij} \cdot \det(A_{ij}) \quad \text{with respect to row } i \text{ or column } j$$

keep your priorities straight.



Engineering Mechanics I – statics:

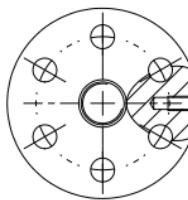


Another one of the two GOP's. As the name suggest this is about statics so everything that doesn't and shouldn't move. It includes forces in the bars of more or less complicated truss systems, stress resultants, energy principles, (virtual) work and friction. Usually, you will be confronted with about one exercise for each topic in the exam. Talking about the exam, it is not only important to understand and solve the problems, but you will also have to be fast. After seeing the problem, you will have to be able to analyse the given system fast and efficient and then, in the best case, already know how to solve it as doing the actual solving work will also take time. In order to do so you will be provided with "cooking recipes" by Jon, the assistant of your Professor Ryll, during the central exercises. Please attend those.

You will learn the basics of solving each exercise type and with the lectures alone you will be lost when trying to solve the homework tasks. Talking about the lectures and homework tasks, in my experience, they didn't help me all too much with the exam. But you will have to find out yourself what is best suited for you so please give everything a proper try. What was however crucial for me, were the old exams. At some point during the semester Professor Ryll will provide you with a bunch of old exams. When preparing for the

exam, solve as many of those as you can. This is the most efficient way to get the speed needed for your exam. As a last point, make sure you understand the stress resultants and the sign conventions during the lecture time while you can still comfortably ask questions. This of course holds true for all the topics but the stress resultants can be quite tricky and usually are worth a lot of points.

CAD/TD (computer aided design and technical drawings):



The CAD/TD course will, whether you like it or not, introduce you to the topic of DIN (Deutsches Institut für Normung) and ISO (International Organization for Standardization) norms, as they are of quite some importance for the topic of technical drawings. You will be provided with those norms by the university, since it would be very expensive to buy them yourself and you might have to use them at some point for one of your homework projects. But more general-ly about the course, you can say that it is split up into teaching general aspects of designing in the aerospace industry and actually working with the program SolidWorks. The teaching aspect is of course done in the lectures. You will learn how to create a technical drawing, rules of technical drawings, rules for computer aided design, rules for designing for manufacture, some manufacturing tech-

niques and also the design flow in the creation of an aerospace product. In addition to that, you will learn how to use the aforementioned program to create your own technical drawings and 3D models of for example a small glider during your homework assignments.

During our course we also had to hand in two of those projects being a technical drawing and a Model of the wing box of an airplane. These two did affect your final grade so please put some effort into it. The program will be taught to you by the assistants of your Professor Daoud so you don't have to learn how to use it on your own, although it makes sense to start working with it and making yourself familiar with the tools it provides beforehand. The course isn't too complicated and the exam comes down to knowledge question about the lecture content, so it is mostly a question of learning things by heart with the addition of a basic understanding of the topics. Unfortunately this course is, although it also contains a lot of general information, very heavily focused on aircraft design with little to no references to spacecraft topics. But that may be forgiven as your professor is a former engineer for Airbus and has mainly worked on aircraft.



Last it might be beneficial to mention that you will be confronted with some of the manufacturing topics again during the second year of AMSP.

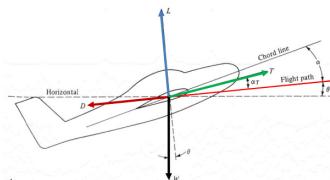


Introduction to Aerospace:

This course is held by a collective of aerospace relevant professors each giving a lecture about their field of expertise. It exists to provide you with an overview of all the possible topics and jobs your study program and further education has to offer in your future. It is a rather easy way to earn 3 credits with small work load. Each week there is an about one and a half hour long lecture, introducing you to a different topic each time. To earn your credits however, you only need to participate in four of them, that you are actually interested in. This is due to the fact, that the credits are not awarded for going to the lecture but for an article you need to hand in at the end of the semester. This article has to consist of four pages, where each page deal with a different topic from the introduction lectures. Writing this article is surely easier than having a whole exam, but you should not underestimate the work of finding so called trustable, scientific sources. As scientific articles are often not written for beginners like us students but for fully grown scientists, it can get very tiresome to find information about your topics from scientific articles, that are basic enough for you to understand and explain in your own article. Still I would say, that it is worth to do the work to get your credits, also because it is just a pass (you get the credits) or fail (you don't get the credits) system for this course without any grades.

I would like to mention, that this information/advice is based on last year's first semester and my personal experience.

As this is a quite new course of study, things are in constant change and optimization, quite like the aerospace industry. So it might occur, that some of the provided information will not hold true for you. Nevertheless, I hope this general overview will help you with your first semester.



Since you might not trust me and want to have a more professional opinion, I asked some of your professors in the first semester for course specific advice. Here is what they said:

Professor Daoud on CAD/TD:

It makes sense to start working with the used CAD software SolidWorks beforehand by maybe watching some YouTube tutorials and learning the absolute basics. As it is right now, the course is close to the manufacturing side and designing for manufacturing, so it also makes sense to make yourself familiar with different processing steps (this will also help with AMSP). YouTube can be of help here as well. In terms of general advice Professor Daoud recommends reading the book "Introduction to flight" by John David Anderson to get a guide to kind of sew the topics of Aerospace together. Also recommended is "aircraft design: a conceptual approach" by Daniel P. Raymen but you should be aware that this is a conceptual approach. Both of these books are available in the library of TUM but as far as I know not available as online pdf.

Professor Herzog on Electrical engineering:

Electrical engineering can be a very hard course, as you can't really grasp the topics that easily. Since you can't really imagine something like a current, magnetism and rotating fields, you have to accept the abstraction and try to understand it. If you refuse to deal with the abstraction from the start, you will have massive problems not to fall behind and get detached from the following topics. Therefore, it is also important to stay focused and keep up with the lecture. As a last hint that you will also frequently hear during the lectures, Professor Herzog tells you to do the exercises yourself, fail and try again but don't be discouraged. It is normal, even necessary to fail and retry in order to learn something. Which generally holds true. – Don't fool yourself.

Thomas Wettemann on AMSP:

The course only deals with the very basics of material science and processing and is designed to provide you with an overview of all the relevant topics, without going into further detail, as there is a lot of potential to learn more. So, don't loose yourself in something too specific and try not to loose sight of the whole picture. When trying to understand a certain processing technique, YouTube can be helpful to get a visual input on the real process.

Good luck with your first semester !!!

Daniel Niemeyer



How to Master?

The master's start: What do I wish I had known before I started my studies?

The master's, an exciting chapter (if not the most exciting chapter) of your academic journey, is coming up. Afterwards, you're always smarter - and to help you perhaps avoid a few of the (very few) stumbling blocks, I've rounded up the things I think might give you an overview of what's to come before you start your studies. I'd like to share some helpful thoughts and tips that have helped me and might be of use to other prospective master's students. Every degree path is unique, and not all advice will apply to everyone. However, I hope that my insights will help you with your Master's.

What's in store for me?

One of the first things you'll definitely want to figure out is how to take exams. Bit lame, but knowing about them now can take a VERY big stress out of your studies. Know the rules and regulations so you don't get hit with unpleasant surprises. Know exactly how your semester progress will be monitored and how many semesters you have left. But don't worry if you fail - it's usually not the end of the world. The important thing is that you know how to deal with it, for example, whether you have to repeat the exam at a later date or whether you can "ignore" the failed attempt, so to speak.

What exactly do I want to specialize in?

One of the most exciting questions in the master's program is the choice of your specialization. Whether you are studying engineering or geodesy, think carefully about the direction in which you want to specialize. For aspiring engineers, there are a variety of options - from aircraft to spacecraft, from helicopters to jet engines. And geodesists face a choice between navigation, surveying, or a mix of both. My tip: Follow your passions and interests. As engineers, you'll probably always have good cards in the professional world.

"Be an active participant in your studies"

What are the opportunities with the job description?

Find out early on about the career opportunities and entry paths offered by your chosen specialization. Consider whether you'd like to see yourself in a start-up or an established corporation, whether research work or a medium-sized company is a better fit for you. And remember: your value as an engineer or human being is never tied solely to your salary. The main thing is to do what is important to you. It may sound cheesy, but in my opinion this is one of the most important things.

How do I get practical experience? Do I need it at all?

While practical experience is helpful, it's not always essential. However, if you want to gain practical experience, look around for student jobs or study teams. But be careful not to lose sight of your work-life balance. Be honest with yourself and find the right balance.

How do I succeed in my studies?

Stay. On. Top. Of. It

Be an active participant in your studies. Ask questions, keep your eyes open for opportunities of all kinds. Your professors, research assistants and the university are there to support and encourage you. Remember to do exercises and follow up on lectures - it makes studying immensely easier. Oh, and start studying for exams on time, you'll thank yourself.

Do I want to go abroad? If so, where?

Think early about whether you want to go abroad during your studies. Which chairs and lectures interest you? Ask fellow students for their experiences and recommendations. Also look for the partner universities of the faculties and also for intra-departmental research exchanges, again, ask ask ask.



Sometimes other countries offer exchange programs that you can "organize yourself". Maybe that would be something for you.

Where can I get help if things are not going well?

It is important to seek support in a timely manner, both psychologically and academically. The university has several places you can go to get help. For example, the FSLRG student council! Be honest with yourself and talk to the appropriate places. Your health always comes first!

Doctoral thesis or not?

Consider whether you want to write a doctoral thesis and if so, in which field. If a field interests you a lot and you definitely want to learn more and do research, consider doing a PhD. For info, talk to the research assistants (WiMis) who often hold your tutorials - they will definitely help you!

The world outside the university

Studying is not the end, but the beginning. There are also many opportunities to develop yourself outside the university. Meet new people, pursue your hobbies and take the

opportunity to find out more at career fairs.

TUM - An excellent choice for your master studies

The TUM is definitely an excellent (Are those flags still flying everywhere?) university for your master studies. And remember: The Master may be demanding, but compared to the Bachelor, many find it freer, more relaxed and more interesting. In retrospect, it may even become the highlight of your studies. Enjoy your time and be open to all the exciting opportunities that will come your way.

You will succeed!

Felix Nitschke

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AI in Aerospace & Geodesy

Introduction

In the last years, some aspects of artificial intelligence have made significant progress breaking some barriers that might lead to a higher level of adoption of automation and data-driven technology in our society. However, current news articles are full of thoughts and expectations that this technology will not meet in the next years – a good reason to join the team and do research in artificial intelligence. And at the same time a good reason for universities to keep calm and moderate the hype instead of fueling it with more and more claims raising unreasonable expectations and emotions in our society.

But what encompasses artificial intelligence at all? Traditionally, artificial intelligence is defined in the context of artificially intelligent agents. In this setting, an agent is formally defined to be a system that contains three components: some **sensors** to perceive the environment, an **agent function** or program to derive an action or plan, and some **actors** that can actually be used to interact with or manipulate the environment. Such agents run in an infinite loop of perceiving the environment, planning an action, and acting. But how does intelligence now come into play? A first step is to define a **rational agent**. A rational agent is an agent that is able to answer to each possible sequence of perceptions of the environment with an action that maximizes a given measure of success. Such optimizations of singular measures of success are very common in the world of engineering and especially in aerospace engineering. For

decades, engineering success in aerospace was measured as faster, higher, farther. Now **artificial intelligence** is defined to be a self-learning and self-adjusting system that can autonomously acquire knowledge and optimize its behavior with respect to multiple and often implicit success criteria. So we could argue it is a rational agent that controls its own rationality autonomously by selecting varying success criteria and resolving tradeoffs.

Imagine a logistics drone that is supposed to deliver a parcel. An example of a rational agent is one that keeps flying, reacts to obstacles on the way, and deliver the parcel in a reasonable time. Such a rational agent can be considered intelligent if it remembers and shares obstacles, explores the environment to have some advantage for future parcels, and updates the path planning algorithms with most up-to-date environmental information. Maybe, even the control has not been programmed, but the system has figured out in a simulation, how to use the motor drivers to keep the drone in a stable flight.

the main question of intelligence is not covered fully.

For example, computer vision techniques can help us to identify certain objects in camera streams in real time leading to perception systems that have been impossible before. Generative models are invented that can even generate additional training data for learning agents like image generators such as DALL-E. In a similar vein, large language models (LLMs) can be used to create surprisingly accurate answers to questions formulated in natural language and can be seen as intelligent agents in certain contexts, when actions are text argumentations.

But while the newspapers are full of claims that these systems would be artificially intelligent, you can easily see that they are not even rational agents as they do not react to every input sequence in a reasonable way. They can be tricked to insult people, to share secrets, and to take unwanted and ethically questionable decisions. This is not what we would typically call intelligent. However, I am not able to tell you what exactly is intelligence. And this is a key problem of the field: everything that is a bit smarter than expected is called artificial intelligence. This frustration leads to a term known as Artificial General Intelligence which resembles a more human notion of intelligence, but let us first explore two models that are useful for students (if not abused to cheat).

State of the Artificial Intelligence

The current hype around Artificial Intelligence is largely a misunderstanding between research and the public. The field of artificial intelligence has made significant progress mainly in narrow domains such as computer vision and lately in natural language understanding and transformation and generative AI. However,



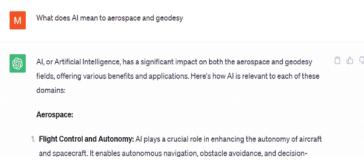
Generative AI – The Future Students Superpower

First a disclaimer: everything that you can achieve with a generative AI should be achieved first with paper and pencil. But when you are careful not to trick yourself, you can gain a lot from working with AI systems of the current generation. The most important aspect is that you have to safeguard correctness and legal issues. For example, it could well be plagiarism to use or even to modify or rephrase the output of such an AI. And it could be that some homework has been designed to be done by you and not to be solved by an AI system. You can only learn by doing things yourself. With these words of a warning, let us rewrite this article using AI.

Chatbots like ChatGPT

The first experiment, I want to report is how ChatGPT actually works for the topic of this article: AI in aerospace. I just wrote the following prompt for the bot:

“What does AI mean to aerospace and geodesy?”



And the full answer was the following:

AI, or Artificial Intelligence, has a significant impact on both the aerospace and geodesy fields, offering various benefits and applications. Here's how AI is relevant to each of these domains:

Aerospace:

1. Flight Control and Autonomy: AI plays a crucial role in enhancing the autonomy of aircraft and spacecraft. It enables autonomous navigation, obstacle avoidance, and decision-making, which is vital for unmanned aerial vehicles (UAVs), drones, and even autonomous aircraft. This can improve safety and efficiency in aviation.

2. Predictive Maintenance: AI can analyze vast amounts of data from aircraft sensors to predict when maintenance is needed, helping airlines reduce downtime and avoid costly breakdowns. It can also optimize the scheduling of maintenance to minimize disruptions.

3. Aircraft Design and Simulation: AI-driven design tools can generate and evaluate numerous design variations quickly, potentially leading to more efficient and innovative aircraft designs. AI also aids in simulating various flight scenarios for testing and training.

4. Air Traffic Management: AI can optimize air traffic control systems, improving the efficiency of airspace usage and reducing congestion. It can predict weather-related disruptions and suggest alternative routes to minimize delays.

5. Satellite Image Analysis: In the context of aerospace, satellite imagery is vital for Earth observation and remote sensing. AI can analyze these images for various applications, including weather forecasting, disaster monitoring, and environmental assessment.

Geodesy:

1. Geodetic Data Processing: AI is used to process and analyze geodetic data from various sources, such as GPS, GNSS (Global Navigation Satellite Systems), and InSAR (Interferometric Synthetic Aperture Radar). It helps in accurately measuring and monitoring the Earth's surface deformation, which is crucial for geodesy.

2. Land Surveying: AI-powered tools can automate land surveying processes, making them faster and more accurate. These tools can process large datasets and identify subtle changes in the Earth's surface over time, which is essential for land management and infrastructure planning.

3. Seismic Monitoring: Geodesy plays a critical role in seismic monitoring and early warning systems. AI can analyze seismic data to detect patterns and predict earthquakes, helping to mitigate their impact.

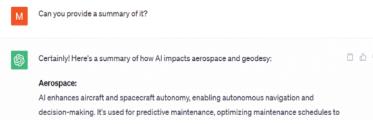
4. Geospatial Mapping: AI can be used to create detailed and up-to-date geospatial maps by processing satellite imagery and other geospatial data sources. These maps are valuable for urban planning, agriculture, environmental monitoring, and more.

5. Navigation and Positioning: AI algorithms can enhance positioning accuracy in applications such as autonomous vehicles and precision agriculture, where precise geodetic coordinates are crucial.



In both aerospace and geodesy, AI brings efficiency, accuracy, and automation to various processes, enabling advancements in technology, research, and applications that contribute to the aerospace industry's growth and our understanding of the Earth's surface.

I think, this is a quite reasonable summary, but it is not complete and not conceptually accurate. For example, image analysis in remote sensing is attributed to aerospace rather than to geodesy which is some conceptual inaccuracy. And more importantly, it is biased towards a positive attitude with respect to AI. No risks, no costs, no ethical conflicts in autonomous flight. Not surprising for an AI system, but still just half of the medal. Beyond, this is also a quite long fragment and feels a bit like copy-and-paste from somewhere. It is not written for an audience like this article's readers. Therefore, let us continue chatting and give some more hints on what we want. So we just continue the dialogue and prompt: "Can you write a summary of it". ChatGPT answers with a more compact and list-free version.



I am not giving the summary as it is still quite long, but I will trick (prompt engineering) the system to be even more compact by prescribing the form of a limerick.



What I like most about this limerick is that it extrapolated from my uninformed prompts into my own field of teaching for aerospace: It summarizes aerospace relating to AI taking flight and guidance and geodesy to measure the Earth. But the last line "With algorithms that are out of sight!" is interesting as it does not relate to my prompts, does it? That is, the Internet training material has "educated" ChatGPT that algorithms do play an important role in aerospace, geodesy, and other fields of engineering. Important enough to add a line to the limerick.

But not everyone likes limericks, so we can as well use other styles and I just asked for a poem. This is now a nice result for this half-an-hour session:

**In the realm of aerospace, AI takes flight,
Guiding planes and spacecraft through day and night.
With autonomy and predictive might,
It soars to new heights, a beacon of light.**

**In geodesy's world, it measures the land,
Processing data with a precise hand.
From GPS to seismic command,
AI aids understanding, helps us understand.**

**From the skies to the Earth's very core,
AI's contributions we can't ignore.
In aerospace and geodesy galore,
It advances knowledge, opening doors.**

Finally trying to get something handy, let us try a prompt: "Can you summarize in a single sentence?" and ChatGPT answers "AI revolutionizes aerospace with autonomous flight, predictive maintenance, and satellite analysis while enhancing geodesy by automating precise measurements, seismic monitoring, and geospatial mapping.". Now the gaps become even more evident than in the long version. This is not a good answer.

Generative AI for Images – Exploring DALL-E

The DALL-E machine learning model has learnt to draw and assemble images and can be used in a quite similar way as ChatGPT. One starts with prompting it and I chose "A spaceship in front of Earth surrounded by a few satellites showing as well a student reading a book."

This brings already a few images, but the system immediately warns you that the description is not very precise.



Figure 1: DALL-E answer to simple prompt.



As you can see, the complexity of the scene leads to a collage of objects and some clipart style, not very impressive. Let us try, whether we can do it better. We start with prompting for more realistic imagery: We first generate a background image from “A photorealistic image of Earth and a rocket and a satellite”. Then, we take a suitable image and edit it. We mark a region that overlaps the generated image and task for this new region “A female student pictured from the back while reading an ancient book in a library”. The system will extend the original image with what we tasked.



Again, we have variations to test and I select one. Let us add a boy as well. Prompting with “A male student pictured from the back while reading an ancient book in a library sitting on the left hand side.” And marking the top-left and top-right area with prompts “complete the sky with a star seen from space” (left) and “complete the image” (right) brings us a final image composition.

The final result, actually, now looks like this:



It is worth noting that this has been generated from text alone. With some time and knowing some graphics programs, one can very well create nice images. Note, however, that I don't know where DALL-E has taken all the information from. I am not sure whether some artist has drawn these books or whether the image of Earth is public domain or not. This will be interesting challenges for our society: how do we modernize copyright and fair use of information available on the Internet without sacrificing all income of artists over time.

Conclusion

On the one hand, it is nice what data-driven systems can do today. We can understand images and language to a surprising extent with comparably simple computer programs and we can do so in real-time such that engineers have a whole bunch of new options of how to implement certain functions into their systems. And we can generate images and text (and many other modalities). Let us jointly explore the vast opportunities that this field is going to bring to aerospace and geodesy in the next decades, but let us as well keep a critical attitude to it and speak up when it is not going to solve major problems. For students, the major activity during their studies should be to learn, to understand and to critically assess what they are doing. So trust your teachers: a homework is typically not a piece of work that your teacher wants solved by an AI. Often, we don't care the answer at all. But in the process of manually generating the answer (paper and pencil), we expect a learning process to be triggered which you will fully miss when solving homeworks with AI. But when you are free to choose the tools (e.g., for presentations), have a look at all those AI tools. And in order to use them best, start studying the field of AI to slowly understand what is going on.

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Liquid Hydrogen as Fuel for Drones

A small technology block on the road to sustainable aviation ?

The civil aviation industry is currently being affected by various trends and developments: "Sustainable Aviation" plays a significant role, which is of great importance in all areas and for all partners in the aviation industry in order to make a contribution to achieving the climate goals. Thus, research and development activities of Zero-Emission aircrafts with alternative propulsion systems in manned and unmanned aviation are increasingly coming into focus.

As an engineering and development service provider with locations in northern and southern Germany as well as France, Great Britain and Spain, the FERCHAU Aviation Group supports the developments of "Sustainable Aviation" with corresponding research competencies within the framework of various – partly funded – research and development projects. On the one hand, by using state-of-the-art engineering methods and tools such as AR/VR and Model Based Systems Engineering (MBSE), the FERCHAU Aviation Group contributes to increasing efficiency and the economical use of resources. On the other hand, this type of modelling approach also shows its potential where new paths are being taken in development of new propulsion technology.

The research project "LiquiDrone" can be mentioned as one example of the research and development activities in the FERCHAU Aviation Group. LiquiDrone is a collaborative research project funded by the Federal Ministry of Digital and

Transport (BMDV), in which the flight duration of drones is to be significantly extended by using an innovative liquid hydrogen storage system.

For this project, FERCHAU Aviation Group member RST Rostock System-Technik GmbH is taking over the management of the research association in which three further institutes are involved: the ZAL (Zentrum für Angewandte Luftfahrtforschung GmbH), the BaltiCo GmbH as well as the Chair of Engineering Mechanics/Dynamics at the University of Rostock. LiquiDrone's focus of research is an intelligent liquid hydrogen tank system and its functional proof. Twelve liters of liquid hydrogen (an equivalent of about 850 grams) are to be safely stored at a temperature of -253 °C for the duration of the mission and made available for electric drone propulsion via a fuel cell system. The increased energy efficiency compared to conventional H2 tanks with gaseous hydrogen opens completely new fields of application for the use of drones (UAS). Using LiquiDrone as an example, with targeted flight times of up to 10 hours, the radius of action for transports could be greatly increased while using sustainably produced hydrogen. Time-consuming inspections in hard-to-reach places could also be carried out much more cheaply



Picture above:
ZALbatros in pressurized hydrogen configuration (Courtesy of ZAL – Zentrum für Angewandte Luftfahrtforschung GmbH)

and, above all, more safely using such unmanned aerial vehicles.

Within this exciting technology project, which is scheduled to run until December 2023, a seven-member team from RST is taking care of the systems engineering as well as the development of a smart integrated interface of the tank to an existing UAS and specific electronics for complex measurement and control purposes, in addition to managing the consortium and coordinating all development activities.

The expected results of LiquiDrone generate an important contribution on the roadmap to sustainable use of alternative energy sources in aviation and industry.

By Ferchau

Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages



FERCHAU Aviation Group

Unser nachhaltiger Antrieb: Die Leidenschaft für Fortschritt



A day with Jon

Engineer, surfer and more.

Exclusive Interview by Shantia Enteshari

The enigmatic [Jon Arrizabalaga](#) leads a life soaked with adventure and drowns in knowledge. Hailing from northern Spain, Jon is pursuing a PhD at the *Chair of Autonomous Flight*. Most of you already know him as the kind-hearted, charismatic head tutor for Mechanics 1, and for any ersties reading this, you will get to know him as that very soon. I had the pleasure of meeting him on a sun-drenched day in the Englischer Garten. We shared stories, laughter, and delved into topics ranging from our hometowns to our shared admiration for Munich, and even our thoughts on the realm of AI. Unfortunately for you, it's rather hard to fit hours of conversation in a magazine. Plus, the star of the show is Jon, not me. So, I've kept this brief and concise. I've given you enough to paint yourself a portrait of Jon, to see him more than just a tutor but as a modern renaissance

Shantia: Jon, where are you exactly from?

Jon: I'm from San Sebastián, in a region called the Basque Country. It's about 20 minutes away from France. It's a very beautiful place. Honestly, if anyone has the opportunity, they should visit. It's really nice, especially during summer. It has plenty of beaches, and lots of good nature. People expect all of Spain to be very dry and desert like. But in the north, it's kind of like Scotland; it's super green, and it rains a lot. But then you also have great weather. And once the sun comes out, it's really beautiful.

S: Now a fact that we share is that we both lived in New Zealand once. It's a very special and unique place with a lot of little quirks and differences to the rest of the world. What compelled to go to New Zealand and what was that like?

J: When I was 16, after having finished a year in high school, during the summer break, I had a chance to go to New Zealand. I still went to school there, but it

was more for the experience and culture. And honestly, it was a great experience. I followed my older brother's footsteps as he did the same. I saw that he had a cool

the people, the life. Especially so, as I lived in a very interesting neighbourhood in the outskirts of Wellington and I was in a high school that was nearly exclusively for Pacific Islanders. The cultural differences were of course very huge. But everyone was super nice to me, and I really enjoyed my time there.

S: You've already told me that you've done an exchange in Shanghai and done your masters in Stockholm. Of all the places you've lived, which two would you visit again and genuinely live in again?

J: That's hard question. Of course, Spain will be there because I believe that the way people live here is unique and magical. And that's a feeling that will always be there for me. It does have its own downsides, but it's home after all. And the second one is challenging. I would either pick Stockholm, or Munich. They were very special cities as, in my opinion, they are the most international cities in their own countries. I've also lived in Stuttgart, for a year, and I've



experience, which was super different to a teenager in Spain, since it's like literally on the other side of the world. So, I told myself why not go there as well. When I got there, everything was of course different; the weather,



visited a few places in Germany. Munich is still my favourite. I think that diversity is something I'd prioritize when having to choose somewhere to live. That's something which lacks in Spain unfortunately, and I would love to change that.

S: How has the Munich's vibe and academic or working environment influenced your current work in autonomous flight?

J: There's no denying that Munich is a very innovative and technically driven city. There are a lot of research centres and universities, as well as a huge range of companies, from large ones to an abundance of start-ups. This had allowed Munich to become an environment that attracts a lot of international talent. I think it's this international pool of talent that has influenced my work. You get to meet a lot of unique people, with unique backgrounds, doing a variety of work and research. I've had the chance to work and collaborate with a lot of people. What's amazing is that you could go from grabbing beer with someone to collaborating with them. That's

something that does not happen everywhere.

S: And after spending a long day doing research, you must get very exhausted. I've heard from few people that you actually surf and go to the Eisbachwelle often. How did you get into surfing, and how'd you discover the Eisbachwelle?

J: As mentioned before, I'm from San Sebastián, which is right at the sea. Since I was a baby, I've always been around the beach. And I remember being little boy, I was always fascinated with surfers and surfing. For me it was the most outstanding thing to watch. As I got older, I was lucky that my parents encouraged me to also pursue surfing. They brought me my first board and by the time I was a teenager, most of my time was spent in the water. Of course, then with university, I had to take it easier. Once I moved to Munich, I knew that the Eisbachwelle was there. So, one day, I just checked it out and saw that it was really good. It was Corona time, so everything was closed; there were no bars or clubs to go to. So, I called my mom, and told her send

me everything - the board, the wetsuit, everything. And I've been going there ever since. I would say it's one of the coolest spots in Munich.

S: Behind every PhD candidate is a passion that ignites their drive. What sparked your passion to pursue a PhD in autonomous flight?

J: During my Bachelors, I studied Mechanical Engineering. Like how students here join student initiatives like *WARR* or *Horyzn*, I joined formula student team. It was a way for me somehow test and play around with stuff and apply what I was learning in the lectures. And that was a great experience. I developed a steering system, and I had a done a great job on it, but I soon realised my knowledge was limited. The issue was that this was an electric car, and coming from a purely mechanical background, my knowledge and understanding of the electronic side of things was very limited. I really want to kind of be this superhero that can fix everything. So, I realized my limitations, and decided to do a Master's degree that would fill this



gap, and I ended up in Stockholm doing a Masters in Mechatronics [focus on Robotics]. There I also joined another student initiative where we were developed a juggling robot, and I started to appreciate the importance of algorithms and programming, and how it can drastically change the way the robot behaves. That led me to do my master thesis with Bosch, where I developed an algorithm for navigation and logistic robots. Up to this point, I never wanted to do a PhD, as I believed that they're boring and only for academia. But I started to realise that in order to achieve greater things with algorithmic side of things, you still have to learn a lot. That's why 4 days into a new job at a start-up, I ended up quitting, making the risky decision to drop everything, and do a PhD here in Munich.

S: You quit your Job, after only 4 days?

J: Yep. Once I was done with my masters, I knew I wanted be in a more dynamic, exciting and intimate working environment. I had already worked in big companies and knew that wasn't

for me. So, I found a start-up and decided to give it a shot. It was good start-up with a dynamic environment, and a great project. But after four days, I realized that it wasn't what I really wanted to do. It was very hard for me to quit. I had to go to the CEO and tell him "Hey, I'm sorry. I really respect what you guys are doing here. Don't take it the wrong way, etc" It was just not for me. It was scary moment for sure. It was during corona as well, which didn't make things better.

S: At some point that ignition you had seems to burn out. How do you keep the fire burning every day?

J: Right now, it's definitely talking to people. Meeting and interacting with ambitious people who want to go beyond what's established is very important for not just networking, but also for your own personal learning. We've already talked about this before, but Munich has an abundance of such people. That's why right now, I don't want to live in Spain because the shared philosophy of my friends there varies drastically with those in Munich. If you're in

an environment where everyone is super excited, doing unique and cool things, and always driven to push on and not afraid to try new things, will in turn inspire you. That is, at least for me, the fuel for the rocket. And that's why I love cities like Shanghai, Stockholm or Munich, because it's full of driven people, that in turn inspire you to do better. This is the advantage you also have in your studies.

S: In the past couple of years, we have seen huge advancements in Artificial Intelligence (AI). How do you think this will influence not only Autonomous flight but also other fields?

J: The effect AI has had is already huge. But in the future its influence will be more prominent. For example, Generative AI (such as Chat GPT) can be drastically improved if its are tailored to more specific tasks and to their users' needs. For example, you could buy a furniture from IKEA, and instead of having some confusing paper manual, you could have a chat interface where the user can both be guided on the assembly as well as reach out if they have any questions. Another



improvement would be coupling language models with mathematical tools such as Mathematica (Wolfram Alpha). This would allow the language models to do math more effectively, and double check its own answers. This is currently a big issue with Generative AI. Beyond what's happening right now, it's hard to say what will happen with AI. I mean no one expected Chat GPT, at least no one from the public. But what I do believe is that like any invention, it will drastically transform aspects of our lives, and of course, it will drastically change how Engineering is done.

S: You probably get asked this to death, but what is next for you? What do you want to after your PhD?

J: Next year, I'm going to the US. I'll be in Pittsburgh for the last year of my PhD. After that, it's going to be a tough decision. I see two paths. One path is to stay in academia and other is to shift a bit towards industry. I do see the benefits in both, but right now, I am bit more oriented towards academia. I do realize that I still have some scientific limitations and I am also completely aware that out there you've got insanely good people. I will always try to improve but I will always be aware that the bar is really high. In academia, having the chance to become a professor is very, very low. You need to be very good; you need to be lucky; you need to be in the right place, at the right time. I'll still be happy to take that venture. But I'm really also aware of the difficulties that would bring. That makes me also consider the second option: a research position within in the industry. Here you might get paid more and have better conditions, but you also end sacrificing a little

bit. You have to sometimes let go of your research interests and do whatever the company needs done. If a position comes out that perfectly fits with my interests, and my research scope, I'll be more than happy to take it. But right now, these are the two options. I hope there is a third, but I haven't found it yet.

S: Every tutor has those standout moments that become cherished memories. Can you share one of your most memorable experiences from your time as the head tutor for Mechanics 1?

“Generative AI can be drastically improved if it’s tailored to more specific tasks and to their users’ needs”

J: Both of the cohorts I've had so far have been very nice. But I have most my fondest memories from 2021 group. My most memorable would be at the very end course. I can't recall the exact topic, but pretty much we were going through a problem with a mistake in the solution. I noticed the mistake in the original solution when I was preparing the tutorial over the weekend. When we got to that point in the tutorial, I stopped and explained what I thought was wrong, and presented what I had thought was the correct solution. Even on the way there, I was in the U-Bahn, at 8 am, reviewing the question, so it would be fresh in my mind. But it turns out, I was wrong. At one point, a student raised his hand and points out my mistake. So, I

had to stop, stand in front of everyone, with no clue. But I felt very comfortable, and I think so did the students. By then, we had got to know each other so well, that there was natural collaboration. And then one of the students raised his hand with some idea on how to do it and we did it together. It was nice seeing that even when the tutor is wrong, the students can point out the mistake and come up with the solution themselves, and everyone can work together to solve it. Even at the Christmas party last year, one of the students came up and we talked about that day.

S: Tutoring offers a chance to directly impact the learning journeys of others. What do you hope your students took away from your tutorials, especially in terms of understanding and appreciating Aerospace concepts?

J: The obvious answer to that is that I hope they understand what the professor explained in the lectures and see the application part of the of it. I also hope that they will realise that maybe what at first seemed like boring equations, actually end up having some insightful applications. That's one very obvious takeaway. But then the other is to realize that in order to solve real world problems, you really need to know the basics. I believe that if you want to do or achieve anything extraordinary, you need to rely on basic knowledge. It's something that you can really, really, really apply to do extraordinary stuff like sending rockets to Mars. So, I would say that like kind of giving awareness of the importance and applicability of whatever they the learning the lectures is important for me.



Space

There once was a king and he had a dream,
the stars under his reign, supreme.

As banner his likeness,
a promise of brightness,
for space an institute founded,
all fear surely ungrounded,
himself-envisioned helmsman,
really more of a strawman,
the chaos began.

Promoted far and wide,
many to the call abide,
but soon for their own place they cried.

Early a spot had been found,
based on historic ground
with problems already inbound.
For the growth came unexpected,
the program overrun,
once again, a tent erected,
as proper places there were none.

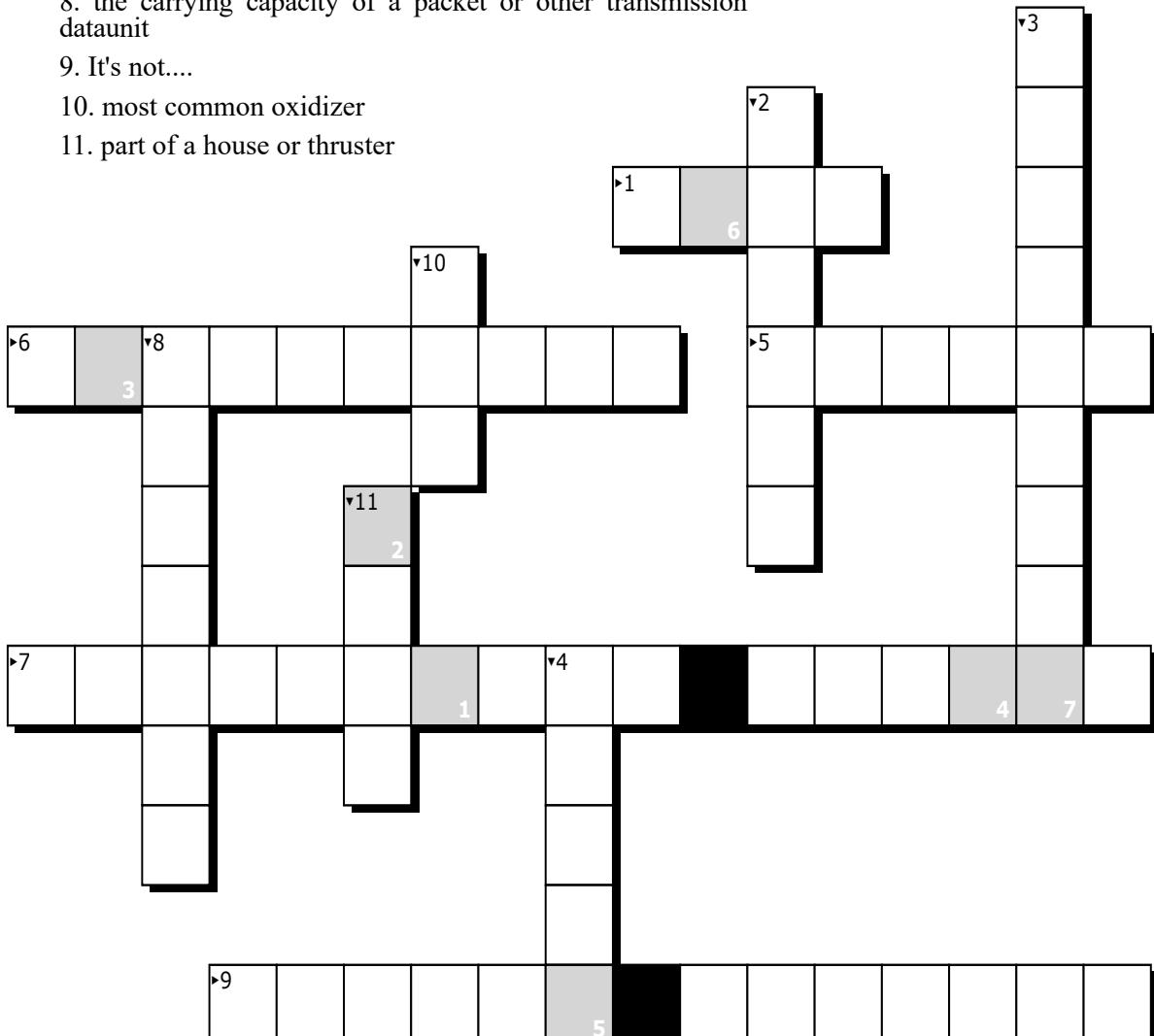
And the king one might ask,
on crusade for his throne,
was he up to the task?

He cared only for the milestone.
For prestige is his currency
a job well done only second'ry.



1. high lift device
2. wing curvature
3. produced from ≥ 2 dissimilar materials
4. path of any spacecraft
5. chinese navigation system
6. $Ma > 1.0$
7. machine that produces thrust

8. the carrying capacity of a packet or other transmission dataunit
9. It's not....
10. most common oxidizer
11. part of a house or thruster



1	2	3	4	5	6	7
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Get ready to put your skills to the test! We're hosting a competition with an exciting prize up for grabs. Stay tuned for all the details, coming soon on Instagram!



Solution 06/23

