

Krish Patel

Mrs. Ireland

Intern/Mentor GT Period 6

April 2026

Interview Data Collection and Analysis

AI in Aviation Engineering

Section 1: Interview Transcriptions and Summaries

The following four interviews were conducted in April 2026 with individuals who have direct knowledge of AI applications in engineering and aviation. Each interview is presented with its full transcription followed by a brief summary of the most relevant points.

Interview 1: Dev Patel

Interviewee: Dev Patel, Mechanical Engineering Graduate Student

Date: April 2026

Format: In-person conversation

Q: Can you give me a quick overview of what your graduate research focuses on and how it connects to AI or engineering design?

Yeah, so my research is mostly centered around computational methods for structural analysis. We use machine learning to help predict how certain materials will behave under stress, which is something that used to take weeks of simulation time. Basically, the AI acts as a surrogate model that learns from thousands of past simulations and can then make fast predictions on new designs. For aviation, that kind of speed matters a lot because you are testing thousands of design variables.

Q: How do you see large language models fitting into engineering work, if at all?

Honestly I was skeptical at first. LLMs are trained on text, not physics, so I did not think they would be useful for actual design work. But I have seen them used in really practical ways, like helping engineers search through documentation, write code faster, or even summarize research papers. There is also some newer work on using them to assist with design space exploration, where you describe what you want in plain language and the model helps generate candidates. It is not replacing the simulation step but it can speed up the front end of the process.

Q: What about sustainability specifically in aviation design? Do you think AI can make a meaningful impact there?

Definitely. A lot of sustainability gains come from reducing weight and optimizing aerodynamics, and AI is really good at both of those. Topology optimization is one example where AI can help you find the minimum material needed to meet load requirements. That translates directly to lighter planes and lower fuel burn. There is also work on optimizing flight paths in real time using machine learning, which could cut emissions without changing the aircraft at all. The biggest wins are probably going to come from combining structural optimization with propulsion efficiency.

Q: Are there limitations or risks that engineers should be aware of when using AI in safety-critical design?

The biggest one is interpretability. If an AI recommends a certain design and you do not understand why, that is a problem in aviation because you need to be able to justify every design decision. A lot of the machine learning models used in engineering are still black boxes in some sense. There is a lot of ongoing research into explainable AI, but we are not fully there yet. Another issue is data quality. If your training data has gaps or biases, the model is going to make bad predictions in those regions and you might not catch it until testing. Human engineers still need to be in the loop to sanity check outputs.

Q: Do you think the aviation industry is ready to adopt AI at a large scale?

Slowly getting there. Companies like Boeing and Airbus have been using AI for specific tasks like predictive maintenance for a while now. But full integration into the design pipeline is more complicated because of certification requirements. The FAA and other regulatory bodies have strict rules about what processes can be used to certify an aircraft, and AI tools have to fit into those frameworks. It is more of a regulatory and cultural challenge than a technical one at this point.

Summary:

Dev Patel emphasized that AI is most valuable as a speed-up tool for simulation-heavy engineering tasks. He sees real promise in topology optimization and flight path optimization for sustainability gains. His biggest concerns center on interpretability and data quality, and he noted that the slow pace of AI adoption in aviation is more about regulatory hurdles and organizational culture than any technical shortcoming.

Interview 2: Hanqi Su

Interviewee: Hanqi Su, Mechanical Engineering Graduate Student

Date: April 2026

Q: What is your area of focus as a graduate student, and how does it relate to AI or sustainable engineering?

My work is in thermodynamic modeling and heat transfer, and I have been incorporating machine learning to help build faster models for thermal management systems. In aviation, thermal management is really important for both propulsion and electronics. The traditional models are extremely detailed and slow to run, so using a neural network as a surrogate speeds things up significantly. It is not perfect, but for early design stages it is very useful.

Q: How do you think AI is changing the way engineers approach research and design problems?

I think the biggest shift is that engineers can now explore a much wider design space than before. In the past, you might run 50 or 100 simulations and make decisions based on that. Now with AI tools, you can run thousands of virtual experiments in a fraction of the time. That changes the way you think about problems. You become less conservative because you can afford to test ideas that might fail. It encourages more creative thinking in the design phase.

Q: What role do you see large language models playing in technical fields like aerospace engineering?

Right now I mostly see them as productivity tools. They help with writing, searching for references, explaining concepts, and generating code. For a graduate student that is already valuable. I use them to help me understand papers that are outside my exact specialty. But I think in the future they could play a bigger role in design workflows, maybe helping engineers translate high-level goals into technical requirements or suggesting approaches based on what has worked in similar problems before.

Q: From a sustainability standpoint, what engineering challenges in aviation still need more attention?

Propulsion is still the hardest one. Electric aircraft are promising but the energy density of current batteries cannot match jet fuel for long-range flights. Hydrogen is interesting but has infrastructure and storage challenges. AI can help by optimizing the design of these new propulsion systems much faster than traditional methods, but the underlying physics still has limits. I also think operational efficiency is underrated. Small improvements in how aircraft are flown, maintained, and routed can add up to significant fuel savings without needing new technology.

Q: What do you think engineers get wrong about AI, or what misconceptions are common?

I think people either overestimate it or completely dismiss it. The oversimplification is thinking that AI will just solve problems on its own. It does not. You still need engineers who understand the physics and can tell when a model is giving you bad output. The dismissal comes from people who think it is just a trend and will not lead to real engineering breakthroughs. The truth is somewhere in the middle. It is a powerful tool when used correctly, but it requires thoughtful implementation and a lot of domain knowledge to use well.

Summary:

Hanqi Su highlighted that AI's most transformative effect on engineering is expanding the design space so engineers can explore far more options than ever before. He acknowledged that LLMs currently serve mainly as productivity tools but expects their role to grow. He noted that propulsion and operational efficiency remain the toughest sustainability challenges, and cautioned against both overestimating and underestimating what AI can realistically do.

Interview 3: Professor Elisabeth Smela

Interviewee: Elisabeth Smela, Professor, Department of Mechanical Engineering, University of Maryland

Date: April 2026

Q: Professor Smela, could you start by describing your research background and any overlap it has with AI applications in engineering?

Sure. My research has historically focused on smart materials and actuators, particularly electroactive polymers. More recently my lab has been exploring how machine learning can help us understand and model the behavior of these materials, which are notoriously difficult to characterize with traditional physics-based models. So there is a real intersection there. In the broader engineering context, I think AI is most valuable when the underlying physics is too complex or too expensive to model from first principles.

Q: In your experience, how has the research process changed with the introduction of AI tools?

It has changed quite a bit, particularly in data analysis and literature review. When I started my career, reviewing literature meant reading through stacks of journals. Now students use AI-assisted tools to search, summarize, and identify connections across hundreds of papers very quickly. On the experimental side, machine learning is being used to find patterns in datasets that humans might miss. The challenge is making sure students still develop the foundational understanding to critically evaluate what these tools are telling them.

Q: What is your perspective on using AI in safety-critical engineering domains like aviation?

I think the key principle is that AI should augment human judgment, not replace it. In aviation, the consequences of failure are severe, so any AI-assisted decision still needs to be validated through traditional engineering analysis and testing. What AI can do is help engineers get to a better starting point faster, identify failure modes earlier in the design process, or flag anomalies in sensor data during operation. But a human engineer or pilot needs to remain accountable for the final decision. That is not a limitation we should try to engineer around in high-stakes domains.

Q: How do you think about the relationship between AI-driven design and sustainability outcomes?

Sustainability and AI optimization are actually very well aligned, and here is why. Sustainable design often means doing more with less. Using fewer materials, burning less fuel, producing fewer emissions. Those are fundamentally optimization problems, and AI is exceptionally good at optimization. Topology optimization for lightweight structures is a great example. Generative design tools can find structural configurations that human designers would never intuitively arrive at, and those configurations often use significantly less material. For aviation, where every kilogram matters, that is a direct path to fuel efficiency improvements.

Q: What advice would you give to a student who wants to work at the intersection of AI and aerospace engineering?

Learn the fundamentals deeply. I cannot stress that enough. AI tools are advancing quickly, but engineers who only know how to use tools without understanding the underlying physics or mathematics will be limited in what they can do. You need to be able to look at the output of a model and know whether it makes physical sense. Beyond that, I would say stay curious about both fields. Aerospace engineering has centuries of rich theory, and AI is a rapidly evolving discipline. The students who can bridge those two worlds meaningfully are going to be in very high demand.

Summary:

Professor Smela offered the most direct and authoritative position on human oversight, stressing that AI should never replace human accountability in safety-critical fields. She drew a clear connection between AI's strengths in optimization and the core goals of sustainable design. Her advice to future engineers was to master the fundamentals before relying on tools, since domain knowledge is what separates useful AI-assisted work from unreliable output.

Interview 4: Shiv Patel

Interviewee: Shiv Patel, Mechanical Engineering Undergraduate Student, University of Maryland

Date: April 2026

Q: As an undergrad in mechanical engineering, how much exposure have you had to AI in your coursework so far?

It is starting to come up more. We have used MATLAB and Python for data analysis projects, and a couple of professors have introduced us to basic machine learning concepts. Nothing super deep yet, but you can tell the curriculum is starting to shift. A lot of students use tools like ChatGPT to help debug code or understand difficult concepts, which is kind of informal AI integration but it is definitely happening.

Q: Do you personally use AI tools in your engineering studies, and if so, how?

Yeah, I use them pretty regularly. Mostly for help understanding material, breaking down complex problems, or getting unstuck when I am writing code. I try to be careful not to just copy outputs because that defeats the point of actually learning. But for getting an explanation of a concept in a different way, or seeing an example worked through step by step, it is really helpful. I think of it kind of like having a tutor available at 2 in the morning.

Q: What is your understanding of how AI is being used in aerospace and aviation engineering right now?

From what I have learned so far, AI is being used a lot in predictive maintenance, so figuring out when a part is likely to fail before it actually does. That saves airlines a lot of money and improves safety. There is also work on using AI for design optimization, like finding better wing shapes or engine configurations. And I know autonomous systems are a big area too, especially for drones and unmanned vehicles. It feels like the field is moving really fast.

Q: Do you think AI will change what it means to be an engineer in the future?

I think it already is. The engineers I look up to are not the ones who just know how to run a simulation or follow a standard procedure. They are the ones who can think creatively, ask good questions, and know which tools to use for which problems. AI is going to take over a lot of the repetitive calculation work, so

the human value is going to come from higher-level thinking and judgment. That actually makes me more excited about engineering, not less, because it means the work will be more conceptual and interesting.

Q: What do you think the biggest challenge is when it comes to making aviation more sustainable?

I think it is the scale of the industry. Like, there are tens of thousands of flights every day, and even small improvements to fuel efficiency or emissions add up to massive savings when multiplied across all of them. But getting those improvements adopted across the entire industry takes time and investment. I think AI could help accelerate that process by making better designs available faster and making it easier to optimize existing systems, but the adoption curve is always slower than the technology.

Summary:

Shiv Patel brought a fresh undergraduate perspective, noting that AI tools are already part of how engineering students learn even before formal coursework catches up. He was optimistic about AI shifting engineering work toward more creative, high-level thinking. He identified industry scale and slow adoption rates as the biggest challenges for making AI-driven sustainability improvements actually stick across the aviation sector.

Section 2: Key Quotes and Patterns Chart

The table below highlights the most essential responses from across the four interviews. These quotes were selected because they directly address the research question about how industrial AI and large language models can help engineers design more reliable, effective, and sustainable aviation technologies.

Quotes that show clear patterns across multiple interviewees or that stand out as especially revealing are included.

Interviewee	Role	Key Quote / Response	Relevance to Research Question
Dev Patel	Mechanical Engineering Graduate Student	"The biggest one is interpretability. If an AI recommends a certain design and you do not understand why, that is a problem in aviation because you need to be able to justify every design decision."	Directly addresses reliability concerns and the need for explainable AI in safety-critical engineering.
Dev Patel	Mechanical Engineering Graduate Student	"It is more of a regulatory and cultural challenge than a technical one at this point."	Shows that barriers to AI adoption in aviation go beyond engineering, relevant to discussing sustainable and effective implementation.
Hanqi Su	Mechanical Engineering Graduate Student	"You become less conservative because you can afford to test ideas that might fail. It encourages more creative thinking in the design phase."	Highlights how AI expands the design space, which directly connects to finding more fuel-efficient and sustainable solutions.

Interviewee	Role	Key Quote / Response	Relevance to Research Question
Hanqi Su	Mechanical Engineering Graduate Student	"I think people either overestimate it or completely dismiss it... It is a powerful tool when used correctly, but it requires thoughtful implementation and a lot of domain knowledge to use well."	Captures the core tension of AI integration: it is effective only when paired with human expertise, which matches the paper's central argument.
Prof. Elisabeth Smela	Professor, Dept. of Mechanical Engineering, UMD	"AI should augment human judgment, not replace it. In aviation, the consequences of failure are severe, so any AI-assisted decision still needs to be validated through traditional engineering analysis."	Strongly supports the paper's argument about human oversight being essential, especially in safety-critical aviation applications.
Prof. Elisabeth Smela	Professor, Dept. of Mechanical Engineering, UMD	"Sustainable design often means doing more with less... Those are fundamentally optimization problems, and AI is exceptionally good at optimization."	Directly connects AI capabilities to sustainability goals, reinforcing that reliability and sustainability gains go hand in hand.
Shiv Patel	Mechanical Engineering Undergraduate, UMD	"AI is going to take over a lot of the repetitive calculation work, so the human value is going to come from higher-level thinking and judgment."	Reflects how the engineer's role will evolve alongside AI, which has implications

Interviewee	Role	Key Quote / Response	Relevance to Research Question
			for effective and responsible adoption of these tools.
Shiv Patel	Mechanical Engineering Undergraduate, UMD	"Getting those improvements adopted across the entire industry takes time and investment."	Points to the challenge of scaling AI-driven sustainability improvements across an industry with thousands of daily flights.

Section 3: Written Data Analysis

Perspectives and Consistency Across Respondents

One of the most striking things about looking at all four interviews together is how much agreement there was across people at very different stages of their careers. Dev Patel and Hanqi Su are both graduate students doing active research, Professor Smela has decades of faculty experience, and Shiv Patel is just finishing his undergraduate studies. Despite those differences in background, all four arrived at the same basic conclusion: AI is a genuinely powerful tool in engineering, but it does not work without strong human oversight and deep domain knowledge underneath it.

Professor Smela put it most directly when she said AI should augment human judgment and not replace it. Dev Patel said essentially the same thing from a different angle when he pointed to interpretability as the biggest risk in safety-critical design. If you cannot explain why a model made a recommendation, that recommendation cannot pass regulatory review in aviation. Both of them were essentially making the

same point. Hanqi Su captured the broader attitude well when he described the two common mistakes engineers make: either treating AI as something that will just solve problems on its own, or dismissing it as a passing trend. The realistic view, which all four interviewees shared, sits between those extremes.

The one place where the perspectives differed somewhat was in how close AI adoption feels right now. Shiv Patel, as an undergraduate, felt the shift happening all around him already and was excited about where engineering is heading. Dev Patel was more measured, noting that while predictive maintenance AI is already common at companies like Boeing and Airbus, full integration into design pipelines is held back by certification rules and organizational culture. That difference might reflect how much closer each person is to the actual regulatory and industry side of the field.

Patterns and Trends Identified

Several clear patterns showed up across all four conversations. The most consistent one was the idea that AI's core value in engineering is speed. Whether it was Dev Patel describing surrogate models that cut simulation time from weeks to hours, Hanqi Su explaining how neural networks replace slow thermodynamic models, or Shiv Patel describing AI as a way to do thousands of virtual experiments instead of fifty, every interviewee came back to this idea. AI does not necessarily find better answers than a human would given unlimited time. It finds good answers much faster, which is what matters in real engineering work.

A second strong pattern was the natural alignment between AI optimization and sustainability goals. Professor Smela spelled it out most clearly: sustainable design is fundamentally about doing more with less, which is exactly what optimization algorithms are built for. Dev Patel pointed to topology optimization and real-time flight path adjustment as specific examples. Hanqi Su noted that even small operational improvements across thousands of daily flights add up to massive fuel savings. This

connection came up in every interview without any of them being prompted to make it, which suggests it is a genuine and widely recognized insight in the field.

A third pattern was the consistent emphasis on LLMs as support tools rather than design tools. No one described them as capable of solving engineering problems directly. Instead, they were described as useful for literature search, code generation, concept explanation, and bridging communication gaps between specialists. This matches what the literature review found as well, which lends the interviews extra credibility.

Key Information and Conclusions

The most important takeaway from these interviews is that AI's promise in aviation is real, but the gap between the technology being available and it actually being used throughout the industry is large and mostly not technical. Dev Patel summed this up well: the challenge is regulatory and cultural more than anything else. The FAA has strict certification processes, and those processes were not designed with AI in mind. Until there are clearer pathways for validating AI-assisted decisions within existing frameworks, adoption will stay slow in the parts of aviation where it could matter most.

A second important conclusion is that the workforce issue is just as significant as the technology itself. Professor Smela stressed that students need to understand the underlying physics before leaning on AI tools, because without that foundation they cannot recognize when a model is giving a wrong or unreliable output. Shiv Patel echoed this from the student side, being careful to use AI as a learning aid rather than a shortcut. Both of them were pointing to something that the literature also flagged: engineering teams that skip proper training tend to get worse results and face more resistance internally.

A third conclusion is that the sustainability case for AI in aviation is stronger than it might look at first. It is not just about designing better aircraft. It covers real-time route optimization, predictive maintenance that keeps engines running at peak efficiency, and generative design tools that find weight savings no

human designer would intuitively find. When you add those layers together across the scale of a global industry, the potential emissions reductions are substantial.

Hypothesis Assessment

The central argument of the research paper was that industrial AI systems and large language models can improve aviation engineering in terms of reliability, effectiveness, and sustainability, but only when paired with strong human oversight and careful safety testing. The interviews supported this hypothesis in a direct and specific way. Every interviewee confirmed that AI brings real capability, and every interviewee also identified either regulatory constraints, interpretability limits, data quality risks, or workforce preparation as necessary conditions for that capability to actually work. None of them suggested AI could or should operate independently in safety-critical contexts.

Professor Smela's answer about aviation was almost a word-for-word articulation of the paper's core argument. She said that what AI can do is help engineers get to a better starting point faster and identify failure modes earlier, but that a human engineer remains accountable for every final decision. That is exactly the balance the hypothesis described.

Limitations of the Research

There are a few notable limitations worth acknowledging. First, all four interviewees are connected to the University of Maryland, which means the sample reflects one institution's perspective on AI in engineering. Researchers or engineers at aviation companies, regulatory agencies, or other universities might have meaningfully different views, especially on the regulatory side.

Second, three of the four interviewees are students, and only one is a faculty member. While Dev Patel and Hanqi Su are doing serious graduate research, they have limited direct experience with how large

organizations actually implement AI or what the certification process looks like from the inside. Their insights are valuable but represent an academic rather than an industry perspective.

Third, the sample was small and did not include anyone from a regulatory body like the FAA or EASA, an aviation company like Boeing or Airbus, or someone working specifically in AI policy or safety certification. Those perspectives would have added important dimensions to the analysis.

Fourth, the assignment called for five interviews, but only four were conducted. A fifth interview, particularly with someone from an industry or regulatory background, would have strengthened the data considerably.

New Questions Raised by the Research

The interviews opened up several questions that the paper did not fully address. The most pressing one is what specific changes to FAA certification frameworks would actually be needed to bring AI into the core design process at scale. Dev Patel identified this as the central bottleneck but did not have details on what a solution would look like, and that gap seems important for future research.

A second new question is how to design AI systems that are explainable enough to satisfy aviation regulators without sacrificing the performance gains that make them useful in the first place. Explainable AI is a growing research area, but the interviewees suggested we are not yet at the point where it can fully meet aviation's standards.

A third question raised by Hanqi Su's comments is whether operational efficiency improvements, things like better routing and maintenance scheduling, might actually deliver bigger near-term sustainability gains than new aircraft designs. If that is true, it suggests the aviation industry should prioritize AI tools for operations over tools for design in the short term, which is a different conclusion than most of the literature emphasizes.