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March 2019

MOMENTUM

THE MAGAZINE FOR STUDENT MEMBERS OF SAE INTERNATIONAL®



STRUCTURED DESIGN

Engineering design process puts Michigan Tech team on road to AutoDrive Challenge improvement

A new perspective

Team from Venezuela takes advantage of varied viewpoints in developing its SAE Aero Design plane

Focus on testing

Getting its car out on the track for troubleshooting early on was a priority for Texas A&M Formula SAE team

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EDITORIAL

MAKING THE CONNECTION



Patrick Ponticel, *MOMENTUM* Editor

Last month in this space, I wrote about the many benefits that come with SAE International Student Membership.

This month, I'd like to focus on one of those benefits: Member Connection (connection.sae.org), which serves primarily as an online written discussion forum for both SAE Professional and Student Members but has additional utility.

Any topic of relevance to mobility engineering is fair game for discussion, be it technical or nontechnical. Often, an SAE Member will declare his or her general thinking on one matter or another, just to get some feedback. Other times, a Member will ask a practical question, knowing the Member Connection community will be there to provide insights and opinions, if not necessarily concrete answers.

Member Connection is a free resource that students could, and should, take advantage of. Always eager to help young engineers on their way up, the veteran engineers whose knowledge and wisdom often finds voice on the site will undoubtedly offer their opinions and relate their experiences to whatever question a student might have about, for instance, a particular technical challenge he or she is facing with their Formula SAE car, SAE Aero Design plane, or Baja SAE off-road vehicle. It's just too rich a resource to ignore, and surely a sign of a good young engineer is exercising the wisdom to tap into the expertise of more experienced engineers.

Speaking of expertise. An occasional feature in the Open Forum (one of the main discussion communities in Member Connection) is "Chat with the Experts." These are two-day discussions led by an SAE staff person who has expertise in a particular area of mobility. The topics, which are predetermined, represent one of SAE's eight technology focus areas. The expert, whose responsibilities to SAE on an everyday basis lie outside of Member Connection, dedicates himself or herself to answering questions posed on that month's technology topic in the discussion.

Since launching in early 2018, the Chats have proven very popular. To review the discussion threads of those posted to date, visit connection.sae.org/participate/sme-technical-discussions. The dates and topic of the next Chat will be announced soon, so be sure to visit Member Connection frequently for the details.

Contests represent another occasional feature of Open Forum. In February, the SAE Membership staff, which runs Member Connection, conducted an Engineers Week contest in which those offering what were judged by staff to be the best answer to each of the single daily questions won a $100 Amazon gift card. Keep an eye out for future contest opportunities.

GET INVOLVED

- Become a *MOMENTUM* contributor by submitting an article. Add that achievement to your resume. Send an email to **momentum@sae.org** expressing your interest in contributing.
- Spread the word about this magazine to other engineering students and faculty, and encourage them to join SAE today by visiting **sae.org/membership**.

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Collegiate Chapters are a way for SAE International student members to get together on their campus and develop skills in a student-run and -elected environment. Student Members are vital to the continued success and future of SAE. While your course work teaches you the engineering knowledge you need, participation in your SAE collegiate chapter can develop or enhance other important skills, including leadership, time management, project management, communications, organization, planning, delegation, budgeting, and finance. For more information, or for how to find your local chapter, please visit students.sae.org/chapters/collegiate/.

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WORKSHOP FORGES THE NEXT-GENERATION AUTO CYBER ENGINEER



CyberAuto Challenge pairs students with leading experts in the mobility industry.

SAE is seeking highly motivated high school juniors and seniors and college students to participate in the organization's CyberAuto Challenge July 21-26 in Warren, Mich. This five-day, practicum-based workshop will help the next generation of engineers learn about automotive cybersecurity and its unique challenges, develop teambuilding and leadership skills, and expose them to high tech careers in the mobility industry. The challenge will feature a series of classroom lessons and discussions alternating with hands-on work using real cars, equipment, and communications protocols. Students will develop critical relationships by working side-by-side with industry experts including automotive professionals, government engineers, and "white hat" hackers. To apply for the challenge, students should first go to cyberautochallenge.us and create an account. They will then be required to send a link to two individuals for a reference by March 26. Finally, students must complete the preparatory educational sessions online during April – June. For more information, email cyberautocallenge@sae.org.

NEW SAE TECHNICAL PAPER COMPETITION LAUNCHES



The mobility industry is rapidly changing, and students and young professionals will be at the forefront of fostering these transformations. The SAE International Membership Team is excited to present the new member-exclusive Student and Young Professional Technical Paper Competition in association with the inaugural SAE Innovations in Mobility conference slated for October 29-31, 2019, in Novi, Mich.

Only the top two student and two young professional papers will be chosen as winners of the competition. The four paper authors will be offered all-expenses-paid trips to the conference, travel and hotel reimbursements, and an opportunity to present their papers.

But all of the authors whose papers are accepted should consider themselves winners in that they will have the distinction of being published by SAE International, gaining exposure to some of the industry's most forward-thinking leaders in the process.

Members are invited to submit their abstract by no later than March 25, 2019. More details are available at sae.org/attend/innovationsinmobility.

TEACHING PHYSICS TO AI SYSTEMS

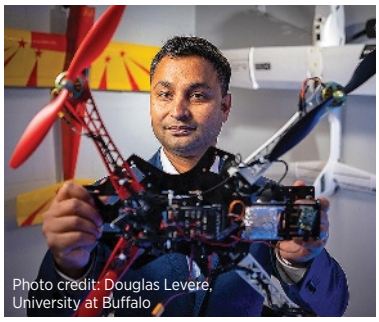


Photo credit: Douglas Levere, University at Buffalo

Rahul Rai, Ph.D., associate professor of mechanical and aerospace engineering in UB's School of Engineering and Applied Sciences, is the grant's principal investigator.

The Defense Advanced Research Projects Agency (DARPA) has awarded engineers at the University at Buffalo a $1 million grant to combine physics-based models with conventional, data-driven artificial intelligence (AI) methods. The goal is to provide AI systems, which work within specific frameworks and lack tools to explain their reasoning process, with a broader foundation of knowledge through physics. For example, by examining the physics of how birds fly in combination with weather and other sensor data, unmanned aerial vehicles (UAVs) will benefit from better collision-avoidance mechanisms. With a better understanding of their surroundings, the amount of data that purely data-driven AI systems require should be reduced and more efficient, and less costly systems should result.

FISITA – TOOLS FOR YOUR FUTURE IN AUTOMOTIVE

FISITA is an international membership organization for the automotive engineering community, and it has useful resources for students and young professionals through fisita.com/yfia.

Utilize the International University Guide, the world's only comprehensive global database of automotive engineering courses. Search for courses that will be of interest to you by university, language, level, or country.

You can also join the FISITA International Engineering Community (FIEC), an online portal for students and engineers worldwide. Get notified about the latest jobs and student internships with some of FISITA's Corporate Members, take part in technical conversations in the Discussion Forum, and access the FISITA Technical Archive.

FEATURE

ENGINEERING DESIGN PROCESS CRUCIAL FOR SUCCESS



The final model of the computer mount design with all accompanying components incorporated.

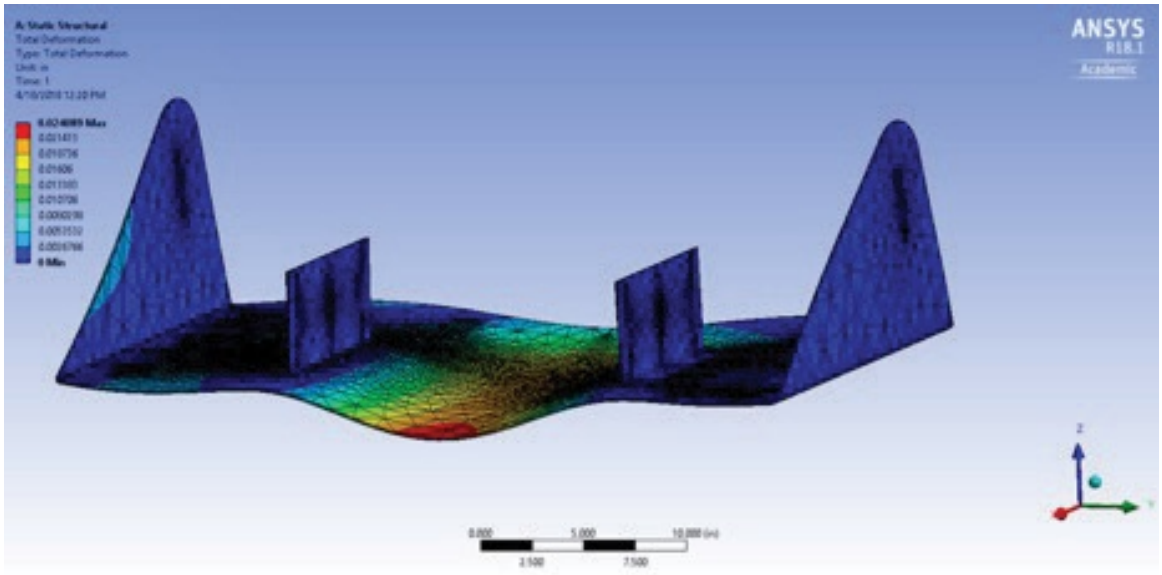
Michigan Tech hopes structured design process yields improvement in Year 2 of the AutoDrive Challenge competition.

CHALLENGING STUDENTS TO SOLVE problems related to autonomous driving and preparing them to move into the industry with autonomous vehicle experience under their belt are the goals of AutoDrive Challenge, one of SAE International's Collegiate Design Series competitions. Furthermore, it teaches students how to take what they learn in the classroom and apply it to real-world problems. Often, it's the first time they are working with 50+ people on one project. This teaches students about cross-team communication and how to make sure everyone is working together to stay on track to meet deadlines. This isn't as easy as it sounds, and often teams need to reflect and see what works and doesn't work so that, moving forward, they can change accordingly to ensure that the project is successful.

Last year, Year 1, was focused on concept selection for the eight university teams in the competition. Each team became familiar with the sensing and computation software and was tasked with completion of a concept design written paper as well as simple missions for on-site evaluation, located in Yuma, AZ.

Michigan Technological University started off Year 1 by splitting our team into sub-teams. The sub-teams were Build, Vehicle Dynamics, Sensor Fusion, and Mission Planning. These sub-teams were comprised of our undergraduate students. Our graduate students worked separately on other tasks for the competition.

I was the Project Lead for the Build sub-team. Our task was to mount onto the vehicle all of the components that would make it autonomous. Going into the spring semester, my team headed the Concept Design Report and Concept Design Presentation events/challenges, which are 2 of 10 for which teams earn a possible maximum of 1,000 total points in the AutoDrive Challenge competition. We started it then because most of the components were mounted on the vehicle by the end of the fall semester or early in the spring semester, so we had most of the spring semester available to work on other tasks. Taking this on at first was daunting, but we soon embraced it and got to work.



A finite element analysis of the final computer mount design. This FEA shows the deformation from a static load of 100 lb with a factor of safety of 5.

The Concept Design Report was due before the main on-track competition in Arizona was to take place, so we got to work on that right away. We poured many Saturdays into writing the report, but it just seemed like we ran out of time. We were pressed to the wire trying to get it done. We didn't have all of our design changes for the car complete to go into the report, so some components had to be left out initially. Working on it right up to the due date left little time for iterations to our report.

For the Concept Design Presentation, we didn't want to make the same mistake. We knew we would need a lot of time for presentation practice and to get critiques from advisors and faculty. We set a date and had our first draft done to start presentation practice a month prior to the competition. Our presentation was constantly evolving. The presentation team presented to different faculty on several occasions. We never felt as though it was finished, and that allowed us to continue to make changes up until the competition. This was a key component that led to our success in this part of the competition.

Another key component was our focus on staying as close to the engineering design process throughout the year as we could. We strived to have a reason behind every design choice we made. This is a concept that is not only stressed within our curriculum, but also was stressed by our advisors. Staying close to the engineering design process provided us with a strong foundation for the concept design presentation.

This was shown in the mounting for the Intel Crystal Rugged server. For the mounting of the server, we started by defining our requirements. Then, several people on our team designed different mounting options. After that, we narrowed the choices down by using design matrices. This ensured that our design met the requirements that we set for the component. Next, we evaluated different material options. Testing was performed with finite element analysis to ensure that the different materials would support the weight necessary and hold up when the car went over bumps or came to quick stops. Again, we used design matrices to ensure that the material chosen stood up to the requirements we had come up with.

Once the design and material were chosen, we fabricated the mount. The mount was put into use, and soon unanticipated issues became apparent. Iterations were made to the original design, and a final mount was produced.

This component of our car is just one of the many for which we used the engineering design process. Following the process made it easy to integrate the component into the presentation. We already had all of the components we needed to explain our design. This method also made answering questions easier because we had a reason behind our design choices.

When it came to presenting at competition, all of the presenters were well prepared to answer any questions the judges had. The presentation went smoothly, and all of the hard work prior to the event paid off. Being a part of the presentation was very rewarding and encouraged the team to want to excel in more of the AutoDrive Challenge events in Year 2.

I was personally very proud of how well our team did in Concept Design Presentation event, placing second. Unfortunately, we didn't perform as well in the other events. We left the competition feeling determined to improve our performance in Year 2.

Once the 2018-2019 school year started in September, we reflected on Year 1 and came up with a plan to improve our performance. We first looked to the Concept Design Presentation—this event was a good template for how we were striving to organize our team for Year 2. We not only learned from our failures from Year 1, be we also were able to reflect on our successes as well and apply them in all areas for Year 2. One key aspect was trying to always keep time in mind—understanding that setting goals with specific deadlines was going to be necessary to stay on track.

Another main goal was not to spread ourselves too thin. A big mistake we made during Year 1 was trying to focus on all of the events/challenges at once. Of course, completing all of the challenges is the end goal,



The final computer mount design integrated into the vehicle with all accompanying components. The Michigan Tech team placed in second Concept Design Presentation.

but with time being a huge factor in this competition, perfecting one or two of the events/challenges and then starting to work on others is better than not being able to perfect any because you are working on them all simultaneously.

Lastly, we wanted to create less of a divide between our undergraduates and our graduate students. We did this by reworking our sub-teams from Year 1. In Year 2, we have graduate students assigned to each of our sub-teams. This provides a much more cohesive environment for collaboration.

The Year 2 competition will take place May 29 to June 4 in Ann Arbor, Mich., and will focus on urban environment driving scenarios with static and dynamic objects. It will be located at Mcity, an urban test facility that simulates a range of complexities that vehicles encounter in urban and suburban driving environments.

We are very excited for Year 2 and are hoping the changes we made will pay off. This competition is an amazing learning experience, not only in terms of exposure to autonomous cars, but also in terms of team dynamics and the experience it provides in taking concepts learned in our curriculum and putting them to use on real-world projects. ■



This article was written for *MOMENTUM* by Angela Xydis, a fourth-year student majoring in mechanical engineering at Michigan Tech. She serves as Co-Captain of the University's AutoDrive Challenge team.

SAE INTERNATIONAL®

IMPACT!

(Definition: Having a strong effect on someone or something; affect, influence, have an effect, have an influence, exert influence, make an impression)

I recently attended an SAE Section meeting. The meeting came to order, minutes were read, agenda items announced, and action items discussed. The meeting proceeded normally, and just before it concluded I heard this comment from a member: "CDS impacts people's lives."

I stopped my conversation, sat back down, and inquired just what the statement meant to the member. He told me his story of participation in CDS events, the two years he worked on his team's project. The nights and weekends spent designing and then building, grinding, welding, and testing their vehicle. He recalled the troubles he and his team had on site, and again the long nights of fixing what broke, making it better (he hoped), and finally the banquet and award programs.

He looked at me and smiled...he told me it was the best time he had in college. I turned my head like a dog does, not really understanding what was being said. The last day of his last CDS event, he was offered a job by a major OEM. He looked me in the eye, stood up and said, "that is how CDS impacts lives."

At his new job, the first thing he did was sign up to be an SAE Member, and he's been one now for over 15 years. He has volunteered at numerous events, giving back to the program. He is an officer of his local SAE Section and volunteers at various events the section runs.

Is this story unique? Of course not. Hundreds, perhaps thousands, of students could relate a similar story. Most of the volunteers at CDS events are past participants with stories just like the one above. Bottom line: "CDS impacts people's lives."

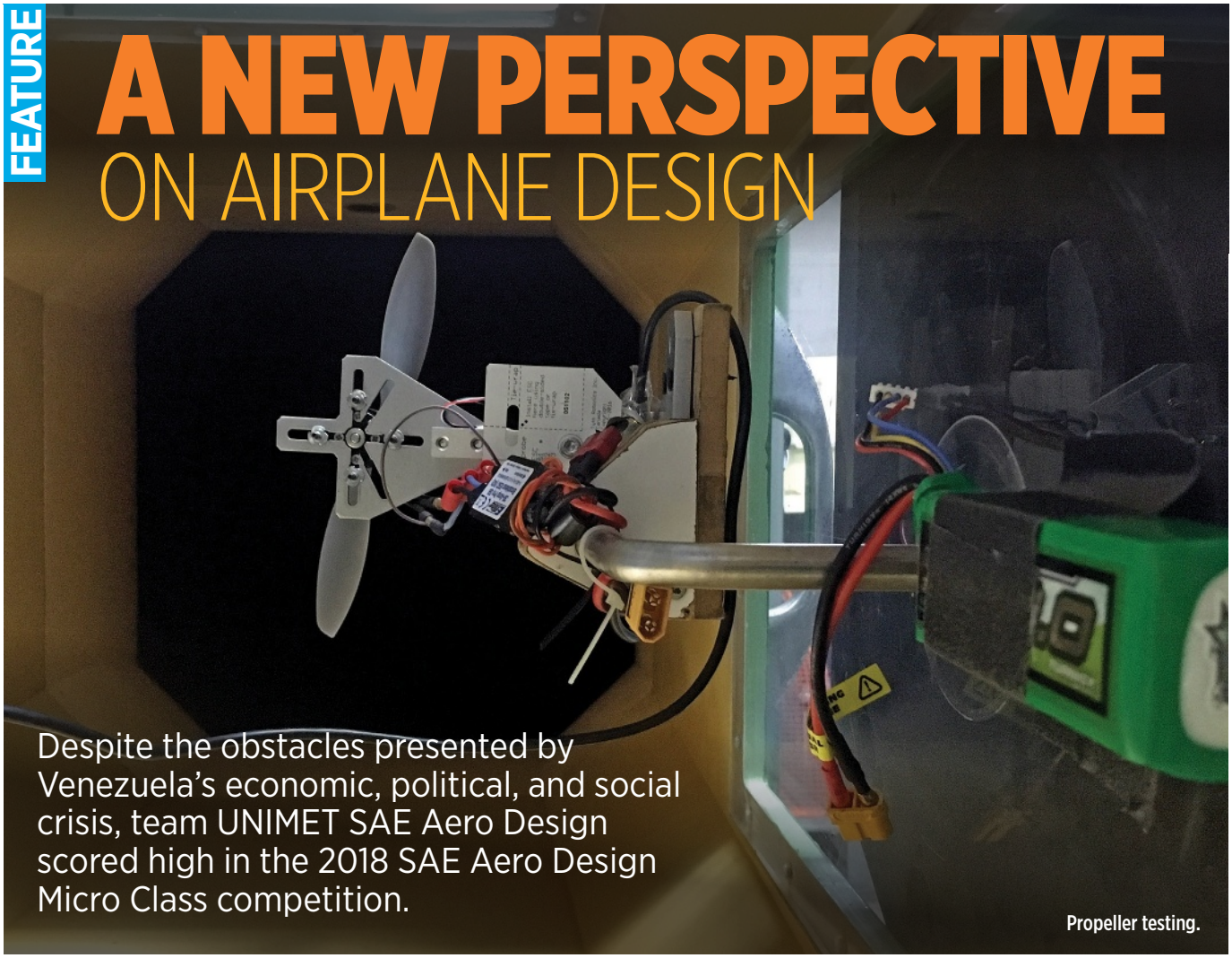
Want to get involved? In 2019, with events in seven states and Canada, there is always an event near you! I encourage anyone who has an interest to volunteer. In addition to all the satisfaction you get, we will toss in a shirt and lunch for the day. Want to be part of this group? Let us know. You can email us at Collegiate Competitions: collegiatecompetitions@sae.org.

Thank you, and have a great season!

Take care,
Sam Barill
SAE Collegiate Design Series Competitions staff team member

FEATURE

A NEW PERSPECTIVE ON AIRPLANE DESIGN



Despite the obstacles presented by Venezuela's economic, political, and social crisis, team UNIMET SAE Aero Design scored high in the 2018 SAE Aero Design Micro Class competition.

Propeller testing.

WE ARE UNIMET SAE AERO DESIGN, a team of engineering students from Universidad Metropolitana in Venezuela. Last year we managed to obtain, among other prizes, 2nd place in the 2018 SAE Aero Design Micro Class competition, even when many people didn't expect us to have such an incredible performance. Their doubts may have been for varied reasons, including the fact that we come from an economically challenged country, or because we are relatively new to the competition. But we had established our goals clearly as a team, and the outcome didn't surprise us at all since we knew from the beginning that our main objective was to design a prize-winning plane. That doesn't mean that the challenge was easy—we had a rough path that we barely managed to overcome. But we learned many valuable lessons that made us the team we are today, and we hope that in sharing our knowledge, other teams can improve and leave their legacy for engineering today.

For us, designing a plane means a lot more than just studying aerodynamic performances, structural integrities, or manufacturing processes. It means having the opportunity to work with people with different points of view and work techniques and providing everything necessary to make the project possible, even when our country is going through a severe crisis. Most importantly, we have the eyes and expectations of hundreds of people that want us to thrive and excel in one of the most prestigious international competitions in the field of engineering. We have the drive to give it our all and make the competition more fun and interesting for other teams.

Our Design Process starts with the Conceptual Design. This is the key aspect of the project, because it is where our team members are the most creative and innovative. We encourage everyone to contribute to the project, even when their ideas may seem impossible or too crazy at first, because their design just might be a prize-winning design. Also, it is important to determine your main objectives and key performance parameters, because for us, engineering must be simple but effective.

To ensure competitiveness for the 2018 SAE Aero Design competition, the team made use of the systems engineering (SE) discipline for the



In flight at SAE Aero Design East 2018.



UNIMET SAE Aero Design captured second place with its Micro Class plane at SAE Aero Design East 2018.

design process. As these airplanes are complex products, they can be structured as a set of different interrelated subsystem levels and components working together toward common aerial objectives. Each subsystem level of the aircraft was evaluated based on different design approaches, and the team selected the best approach, keeping in mind those quantifiable expectations of flight performance organized in objectives and key performance parameters (KPP). To define these objectives and KPPs, first the team had to understand the rules and principal constraints involved in the design process.

One of the most difficult challenges in the 2018 competition was to select the correct amount of PVC pipes to lift, and their optimum length, ensuring that all of them fit in the given container dimensions, and leaving as much space as possible to also fit the aircraft system. Hence, we proceeded to make a score analysis to determine the required payload weight, considering that it is crucial to fly in all competition rounds.

To study the storage alternatives and ensure the maximum use of space, the team made use of SolidWorks software. After packing the payload, the space available for the airframe was 11.825x13.625x1.000 in, so it was important to calculate the optimal wing surface that would ensure the estimated payload weight could be lifted; in the same way, it had to allow room for the tail and the propulsion system. For this reason, using an analytical technique dependent upon aircraft performance requirements such as stall speed, maximum velocity, and rate of climb, the team was able to determine the necessary wing area, as well as the required power for the propulsion system. Additionally, some aircraft parameters used in this technique were reinforced by analysis and different empirical tests such as stability, drag, lift, and thrust analysis, taking advantage of the university's low-Reynolds number wind tunnel.



Assembling the plane.

Once the prototype was manufactured, the team tested the YV-UM09 on a flying field in Caracas at a density altitude of 4700 ft. We managed to lift the maximum total weight of 2.5 lb, which corresponds to a weight of 3 lb at the competition site's altitude given by the payload prediction chart made for the town, and the weight that indeed, Spirit of Caracas, managed to lift at competition.

Following the success of past years' competitions (particularly the last one) and considering that rules have not dramatically changed, this year's technical approach was all about developing some of the design concepts that our UAV prototype needed to improve and assuring the main objective: winning first place in all four categories of the competition.

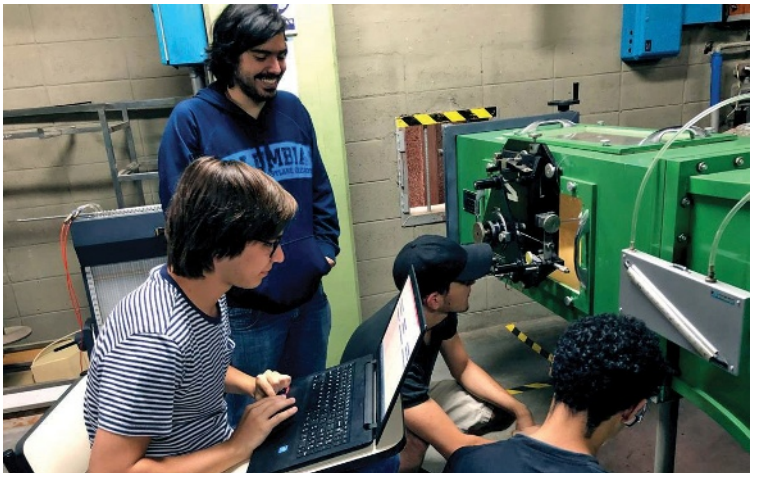
By using the same systems engineering approach as past years and breaking down the design process as mentioned earlier, we focused this year on improving three main aspects: faster assembly demonstration, quantified and tested aerodynamics design of surfaces, and increased propulsion and alternative tools.

FASTER ASSEMBLY DEMONSTRATION

Last year's assembly demonstration event was probably the main reason why our prototype didn't assure the first place overall. Only eleven points were the difference between first and second place. UNIMET's demo score was



Planes in the Micro Class get a hand-thrown launch.



Wind tunnel testing.

only 0.1350 points, which is significantly smaller than the average of 12.6 demo points for our top four competitors. Our assembly demonstration was held in about a minute and forty seconds, and given that the rules have not changed, our goal is to dramatically reduce that time to about 45 seconds by using an improved modular design on the same pod-boom configuration.

To assure that we can lift the maximum amount of PVC pipes for a greater number of flights, the proper prototype takeoff weight was determined, and the lifting and control surfaces were sized by analytical, computational fluid dynamics (CFD), and experimental approaches. The prototype space distribution was tested inside the same 11.825x13.625x1.000 in box, and the stress resistance was evaluated using SolidWorks CAD software.

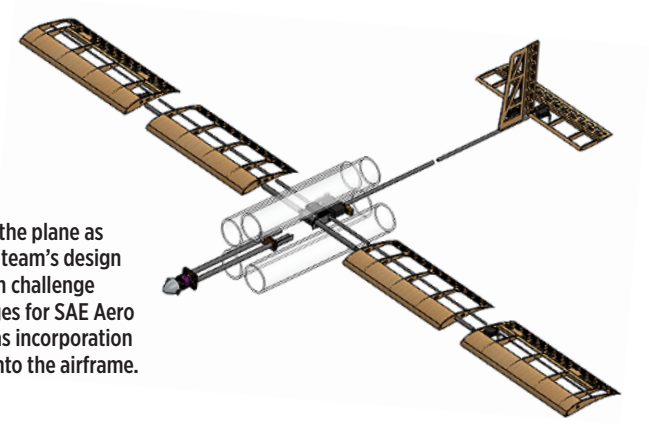
QUANTIFIED AND TESTED AERODYNAMICS DESIGN OF SURFACES

Some of the aspects of the iterative design process in which flow results were validated by CFD evaluation (Xflr5, Xfoil) to guarantee flight performance requirements such as stability and control were substituted by a more analytical approach.

The sizing of control surfaces, for example, was developed to reach the greatest performance under specific flying performances such as inverse yaw (rudder) or takeoff trim (elevator). The tail sizing was formulated too, instead of being iterated to guarantee longitudinal stability. A significant number of analytical calculations and CFD validations were conducted to guarantee the maximum level of operation of each of the surfaces.

INCREASED PROPULSION AND ALTERNATIVE TOOLS

One key performing aspect of this year's design is being able to achieve a greater propulsion. For that, new methods such as emerging computerized neural networks were evaluated to predict and optimize aerodynamics variables on the propulsion system, making sure that it is adequate for our prototype to increase the aircraft's endurance and improve its general performance.



A schematic of the plane as depicted in the team's design report. A design challenge created by judges for SAE Aero Design 2018 was incorporation of PVC piping into the airframe.

When we arrived at the competition, we were determined to show that being an engineer is more than studying and analyzing; we wanted to share what we learned with other teams and make the competition more human. We celebrated each of our flights because they represent all of the hard work that we put into the YV-UM09. Even when our plane crashed, we didn't become discouraged, because it meant that our design could be better, and we want to keep working on improving our design.

Despite the obstacles presented by Venezuela's economic, political, and social crisis, we managed to represent our country's academic excellence, winning second place in the overall score, first place in the highest payload performance, first place in the oral presentation, and second place in the written design report. We came back with our head high and ready to keep working hard, learning and progressing. This is only the beginning, as we are ready to continue proving our commitment to progress and technological innovation at SAE Aero Design East 2019. ■



This article was written for *MOMENTUM* by Seane Correa, the team captain for UNIMET SAE Aero Design who expects to graduate from Universidad Metropolitana with a bachelor's degree in computer science in 2020.

FEATURE

FOCUS ON TESTING FUELS WIN



Fuel system engineer, James Compton, gleefully tests the prototype rebar chassis.

Texas A&M Formula SAE team members develop valuable engineering skills as they apply the fundamentals of engineering to a complex problem that just happened to be a racecar.

FROM DAY ONE, our advisor, Yuval (UV) Doron, made it very clear our primary goal was not to win a competition. He said, "This course is not about building a racecar. If you even finish building the car before the year is over, I will be amazed. If that car works properly, I'll be even more impressed. If the car completes even one lap at competition, even better. If it finishes the entire competition, that will be something to be proud of, let alone winning. This course is not about building a racecar."

We were instructed to focus on becoming skilled, competent engineers by applying the fundamentals of engineering to a complex problem that just happened to be a racecar. Mechanical Engineering 401 and 402, Introduction to Mechanical Engineering Design and Intermediate Design, respectively, were about proving to the university that we deserved the title of Engineer, not about building a fast racecar. Even so, winning a racecar competition is exactly what we did in Lincoln, Nebraska last summer. Keeping the team focused on earning the title of Engineer while balancing the desire to win was key to that success.

The team had two jobs over the course of the year. Before we could even dream of designing, building, and developing a racecar, we had to grow into a team capable of doing so. First, one member suggested that, each week, a sub-team stand at the front of the class to field questions from the entire team. Week by week, the Chassis, Aerodynamics, Electrical, Powertrain, and Suspension teams were grilled by the rest of the group to test the limits of their knowledge. These "sub-team roasts," as we so affectionately called them, allowed the entire team to heavily critique every single part of the car as well as each team member's knowledge. Individuals were not only expected to know their own parts, but the role these parts played in the vehicle's overall design. This exposed everyone to the pressures that would be seen in the design phase of the competition and allowed each member ample opportunity to practice answering technical questions. It often functioned as a rehearsal for the Design Event portion of Formula SAE.

To further facilitate team development, we created common procedures to thoroughly document every design decision. Each team member was expected to complete a lab-report style write-up for every major decision. These decisions included suspension type, tire selection, engine selection, wire gauge, airfoil element selection, chassis material, and many others. The justifications included all of the explored options, relevant engineering principles, background research, equations and calculations used in the decision, and any other information relevant to the decision-making process. These were published to the shared team drive, reviewed by team members throughout the year, and then used to write the final report. The final report was a comprehensive 400-page document detailing everything about the car including design, manufacturing processes, development, and testing.



Powertrain tuning specialist, Seth Burkhalter, collects ECU data after a run with driver Gill Lipton at the wheel.

The requirement to produce these documents forced the team to heavily consider every decision made throughout the year, while also allowing these decisions to be communicated to the rest of the team in a structured manner. This was crucial to preparing for competition and ensuring a thorough understanding of the vehicle by everyone.

Finally, UV's approach to advising the team had a great impact on the team development process. He felt that the best way for engineering students to learn was by finding their own solutions to their problems, no matter how difficult or time consuming. We were never offered much direction when it came to vehicle design. At first, when deciding whether we wanted to build a sidewinder car, UV told us he did not care either way as long as we could justify it with sound engineering principles. There were times, however, that he provided much needed guidance. He would often point out when our justifications were flawed, or would guide us when our understanding of a topic was insufficient to see our own errors. He often discouraged us from seeking outside advice from alumni and other engineers in the hopes that we would learn to listen to our own instincts and educations as engineers, a skill that would carry us far once we were out in industry. I firmly believe that UV's approach to advising our program allowed us to learn far more than if he had "held our hands" along the way.

UV's guidance also bled over into the actual racecar portion of the project, but more than anything we were fueled by our desire to win when crafting our approach to vehicle design, construction, development, and testing. First, we looked to the history of Texas A&M Formula SAE. In the previous five years, Texas A&M had three Endurance Event "did not finish" (DNFs), one victory, and one second-place finish. This information told us that our number one priority had to be finishing every dynamic event—Acceleration, Skidpad, Autocross, Fuel Economy, and Endurance. It was clear that we could build a competitively fast vehicle, but that meant nothing if it did not finish the race. As the old adage goes, "to finish first, first you must finish."

Thus, the true challenge resided in designing a car that could do everything we asked it to when the week of the competition arrived. The science behind making a racecar fast was simple—we could learn that from books. However, the science behind making a fast AND reliable vehicle was far less accessible. Finding a balance between building a lightweight but reliable car was a terrifying prospect for young engineers. The only real example we had of how to accomplish such a task was the 2017 Texas A&M team. The 2017 car accumulated



The team tilts the car to change the tires at competition.



Driver Michael Ilavia pilots the Girth Stallion in Lincoln, Nebraska.



Driver Chris Fleming brings the car in for an inspection on its inaugural drive.

over 700 miles of testing before heading to Lincoln to compete. We knew we had to get the car out to the test facility early and often.

To obtain the required testing time, the team decided it was essential to begin driving the car around spring break in mid-March. The 2017 team was able to complete their first drive around Valentine's Day and commenced serious testing in mid-March. Their timeline was extremely aggressive for our team, considering we first met in late August and Hurricane Harvey delayed us by a week—effectively pushing our start date to early September. With these set-backs, it was no surprise that the 2018 car was not ready until late March and heavy testing was not underway until April.

Achieving this desired timeline was no small feat and required extensive planning by our team's leadership group. Unfortunately, our understanding of the design and manufacturing process was very limited at this point in our careers. To give ourselves the best shot possible at hitting our desired timeline (and burning through as many sets of tires as possible), the team decided to limit our design phase to an uncomfortably short period. We froze designs in late November/early December, essentially giving us only three months to design.

At first glance, one might believe a longer design phase to be more beneficial to our reliability goals. After all, there is no arguing that a more thoroughly designed system would be expected to function better and tend to be more reliable than one designed in haste. However, our specific situation simply did not align with this school of thought. We could only take educated guesses at our loading cases for suspension design, our aerodynamic loading numbers were merely estimates, and the cornering and braking performance were pure speculation. Knowing the scope of these limitations, we decided that a few extra weeks of design would not help us nearly as much as the few hundred extra miles of testing those weeks would yield. In the end, we were grateful for the extra track time, as we found major mechanical issues in the weeks leading up to competition and finished an engine-out repair in the garage near our hotel in Lincoln the night before competition began.

Looking back on this experience, UV was right—the course was not about building a racecar. Although I did not believe it at the time, the things we learned extended beyond the world of racing and automobiles. In fact, a majority of what I learned personally had nothing to do with building cars. The racecar aspect of our program was merely a tool to teach engineering students the fundamentals behind applying their education to any engineering problem. Some of the most valuable lessons taught by this project were of learning to trust our own instincts and to respect ourselves as engineers, but also knowing when to seek out help. We also learned about project management. We learned that it is often important to seek out and incorporate alternate approaches to avoid focusing on what may appear to be the correct approach. All of the team members, at some point during the project, made difficult engineering decisions that impacted the final car: a car that brought home 1st in Endurance, 2nd in Autocross, and 1st Overall. ■



Spencer Weaver, project manager for the 2018 Formula SAE team at Texas A&M University, wrote this article for *MOMENTUM*. He graduated with a bachelor's degree in mechanical engineering and is working as an engine performance and valvetrain analyst for General Motors in Michigan.

MIDNIGHT MAYHEM: RACING IN THE DARK

LOUISVILLE MIDNIGHT MAYHEM is an annual exhibition race, hosted by the University of Louisville and organized by Louisville SAE Baja Alumni, for student-built vehicles conforming to the rules of the Baja SAE series. While this event is organized around the use of Baja SAE vehicles, SAE is not directly involved with the organization and operation of the event.

Students from across North America to travel to Kentucky, test new designs and ideas, show new members what Baja SAE is all about, and race wheel-to-wheel against over 50 other colleges and universities in various racing events.

Like any other event for Baja SAE teams, Midnight Mayhem's feature event is an endurance race that challenges teams to navigate a course full of rocks, logs, jumps, and other obstacles to see whose car can make the most laps in four hours.

But what makes Midnight Mayhem different? The endurance race is held in the dark! Racing lasts from 8:00 p.m. to midnight, making Midnight Mayhem the only Baja SAE-related event hosted "under the lights," which is why teams come back for this unique experience each year, said Diandra Sawyer, a chemical engineering major at the University of Louisville's J.B. Speed School of Engineering who is serving as PR and Business Captain of the university's Baja SAE team.

On October 12 and 13, 2018, Louisville Baja SAE's alumni hosted the 10th annual Midnight Mayhem. Teams can bring up to three cars that have passed tech at an SAE event in the last five years. Nearly 1100 students attended Midnight Mayhem, which was 400 more than the year previous.

For the fifth year in a row, Mayhem was held at Nickota Motocross Park in Bedford, Ky. (about 45 minutes away from the University of Louisville). Because Nickota allows the alumni to dig, event organizers can change the endurance track and the areas for the other dynamic events every year, so even returning teams have new challenges to face.

With this being the 10th anniversary of Midnight Mayhem, the alumni wanted to make the event special, so for the first time, there were two days of racing. After tech inspection on the first day, teams from different schools were put in groups together to compete in Sundown Showdown, a Baja relay race. The cars were randomly placed onto one of up to 20 teams. There were five cars per team, and each car was from a different university.

Teams braved the rain to compete in the unique relay-style event that was aimed at getting universities to meet and work together to come out on top. The relay race was conducted similar to a relay race run in a track and field event. One car from each team completed two laps around the track as fast as possible. On completion of lap two, the driver entered the fuel pits, pulled in to the designated area for his/her team, turned off the car, got out, and "passed the baton" by running to start the next car for their team. The first team to complete 10 laps (two per car) won the heat. The final heat of the evening was the Championship heat, in which the winners of the previous heats competed for the top spot.

Thankfully, Sawyer said, good weather came on Saturday, allowing for a perfect day of dynamic events and then a traditional four-hour Endurance Event that was won by the University of Wisconsin–Stout.



University of Wisconsin-Stout's winning Baja car.

Second place in the Endurance Event went to Western University and third place to Grove City College. The overall winner was University of Wisconsin–Stout, followed by Western University in second place and University of Maryland, Baltimore County, in third.

"None of us really expected [to win]," said UW-Stout team president Tony Wierzba. "It was a pretty successful weekend." The UW-Stout team has about 20 members, four of whom participated in Midnight Mayhem 2018: Sean Durian, Colin Mittelstaedt, Jason Richardson, and Derrike Suckow.

Louisville Baja SAE's "very green" team with many freshmen had a rough couple days, said Sawyer, finishing 90th overall.

Midnight Mayhem has become one of the largest exhibition races for Baja SAE cars, said Sawyer. "At Mayhem, teams get to test new design elements, get some live race data acquisition, but most of all have fun in old cars they dedicated a year of their life to. With the location and setup of the event, teams also camp together for two nights, which not only leads to the exchanging of ideas and tips, but it becomes a place to meet and reconnect with people at national events."

A group of about 10-12 Louisville Baja SAE alumni organize the event. ■

2020 SUPRA: TOYOTA'S JAPANESE SPIN ON GERMAN ENGINEERING

IN TODAY'S WORLD of rationalized product lines with optimized bills-of-material sharing for maximum scale, the corporate case for low-volume sports cars is tricky. A desire to return its Supra (last produced in 2002) to production led Toyota to partner with BMW, sharing the Cluster Architecture (CLAR), underpinnings, and drivetrain from that company's latest (G29) Z4 roadster and contracting out assembly to Magna Styr's Graz, Austria plant.

It makes for a strong example of the benefits of global markets, as this arrangement lets Toyota return a flagship sports car to showrooms. It even features an inline 6-cylinder engine, which was a hallmark of earlier Supras. The shared parts leave fans wondering whether the 2020 Supra is a real Toyota, or just a BMW in disguise.

In this case, the engine is an undersquare BMW 3.0-liter inline 6-cylinder, code-named B58M30 01, rather than the 2JZ of the previous Supra. In Supra specification, the engine is claimed to deliver 335 hp (249 kW) and 365 lb·ft (495 N·m), which compares to 382 hp and 369 lb·ft (285 kW and 500 N·m, respectively) in the Z4. Toyota doesn't want to discuss whether there are any hardware differences between the engines, leaving the possibility that the Supra is a simple software upgrade away from BMW-level power. Both cars use a ZF-supplied 8-speed planetary automatic transmission driving the rear wheels.


Photo credit Toyota

The 2020 Toyota Supra coupe exhibits some hints of its Toyota sports car heritage, though it shares its architecture, underpinnings, and powertrain with the BMW Z4 roadster.


Photo credit Toyota

Chief engineer Tetsuya Tada says the Supra was developed to be a balanced sports car, without concern with how it compares to the Z4.

Differences seem to be mostly cosmetic, along with a different state of engine tuning. The styling clearly includes cues to historical Toyota sports models, but still manages to look like a Z4 because of the underlying proportions. "It combines the heritage of the 2000 GT, the 86 and the Supra," insisted Tetsuda Tada, chief engineer. "We made sure there were remnants of that in the side view."

But other than visually, Toyota didn't seek to push the Supra away from the Z4. "It wasn't a specific intent to differentiate," explained Tada, who insists that Toyota doesn't know anything about the Z4. "Toyota had a vision of what a Supra should be and created it. Our car is a coupe and theirs is open, so the advantages of each are different."

The transmission is the same, even if manual-shifting enthusiasts might wish it were different. "The automatic transmission is highly refined," said Tada. "It is geared so you can concentrate on driving." He doesn't rule out a manual, however. "If the market demands one, we'd consider it." And maybe there could be engine upgrades too. "BMW has variations of the engine, 500-horsepower ones," Tada noted. "The beauty of sports cars is always looking for improvement."

If Toyota had input in BMW's development of the chassis, it may have been the requirement to design the production car with racing modifications in mind from the outset. "It is the first volume Toyota built with the premise of being a racecar," Tada said. "The hardest part of building a racecar is being able to cool it. If you can cool it, you can extract maximum performance. There is space for an enlarged radiator and passages for airflow." ■

By Dan Carney, contributor, SAE Mobility Media

OVER-THE-AIR AFFAIR

VEHICLE CONNECTIVITY is no longer an option in a world where the Internet of Things (IoT) continuously casts a broader net on the number and types of devices that interact with each other and exchange data.

"We look at a vehicle as simply a node on the Internet of Things," Andrew Dondlinger, VP and General Manager of Connected Services at Navistar, said at the 2018 SAE COMVEC event. "Frankly, we believe that if you're not a connected fleet or you're not a connected OEM, you'll be out of business."

In the commercial vehicle (CV) sector, uptime is a major driver of increased telematics and connected services. Navistar is striving to achieve 100% uptime—an aggressive target but one that becomes necessary as the industry moves to more highly automated vehicles, according to Dondlinger.

"As we move toward electrification, we can get to 100% uptime," he said. "And as we move toward autonomy, we have to have 100% uptime."

Over-the-air (OTA) programming, which allows remote software updates without the need for a service visit, will play a key part in achieving this goal. Engine reprogramming of specific parameters has become a common application for OTA updating, ensuring the powerplant is running the latest calibration to reduce faults and improve operational efficiency.

Many heavy-duty engine makers, including Cummins, Detroit, International and Volvo Trucks, now offer OTA engine programming. The Detroit Connect platform, for example, enables OTA parameter changes and extraction of engine performance reports. The cellular-based remote updates are exclusive to the new Freightliner Cascadia spec'd with Detroit engines.

The time saved can be significant. Volvo's remote programming of software takes less than 20 minutes, compared to a couple days of downtime to complete standard software downloads at a service location, according to Ashraf Makki, product marketing manager for Volvo Trucks North America. The process has already added thousands of days of uptime to its trucks, he said.



Image source: Volvo Trucks

Over-the-air parameter updates for trucks equipped with GHG 2017 Volvo engines and connectivity hardware include transmission performance mode, max road speed limit and max engine speed.

Remote software updates are "not just about fixing things," Herwig Peschl, global marketing director at Caterpillar Inc., explained during the company's annual year-end press briefing in Peoria, Ill. "It's also allowing us to get new features on machines" that are already in the field.

A range of Cat machines are remote-flash enabled, including its next-generation excavators, all M3 series motor graders as well as the 140 and 24, and M series wheel loaders.

"This will revolutionize the way customers can interact with their machines," Peschl said.

Among the 24 new machines Cat revealed at the briefing were the 330 and 336 hydraulic excavators. They follow the introduction of the 320 and 323 next-generation excavators a year earlier, which were developed with the ability to be "very easily upgradeable through apps, if you will," said Brian Stellbrink, product application specialist.

"By using the base machine and the electrohydraulic system, we're able to continue to offer new features via software that are available for the new 330 and 336 from the start," he explained. "But maybe more importantly, these new technology features through software can be applied to a machine that was put into the field 12 months ago."

As long as new hardware or a calibration is not required, the updates can be performed through remote flash, according to product application specialist Ryan Neal. A Lift Assist feature, which was still being developed when the 320 and 323 were launched, is one such example. It provides the operator with real-time information on the weight being lifted and where the safe working limits are for the machine. ■

By Ryan Gehm, editor-in-chief of SAE's *Truck & Off-Highway Engineering* magazine

SAE 101: MARCH 15 IS DEADLINE FOR SAE SCHOLARSHIPS

(SAE 101 examines one aspect of SAE International per issue.)

Through generous contributions from individuals and organizations, SAE International is proud to award scholarship money to both undergraduate and graduate students pursuing engineering and related science degrees. Funded through the SAE Foundation, they encourage academic excellence and help students pursue their passions.

There are 16 scholarships, each with its own unique eligibility requirements. But what they all have in common is a March 15 application deadline. Visit sae.org/participate/scholarships for more information about the SAE scholarship program and for application forms.

"SAE's robust scholarship program provides recognition and support to some of the best and brightest students pursuing engineering and related science degrees and gives donors a very personalized way to give," said Lori Gatmaitan, Director of the SAE Foundation. "SAE scholarships are a natural extension of our holistic approach to providing integrated, hands-on STEM learning opportunities for students from pre-k through college."

Each scholarship is endowed (created and funded) by an individual, company, or organization. Since 2015, the number of SAE scholarships offered increased from 11 to 16. In the past four years, 119 students from more than 15 different states have been awarded $316,500 to pursue their education.

The Dan and Vicky Hancock Scholarship for Mechanical Engineering Excellence is among those that are open to undergraduates in any year of study. It is named for former SAE President Dan Hancock (2014) and his wife. Hancock has been a major SAE International and SAE Foundation supporter. The SAE Fellow has been a member of the organization for 45 years, among other things serving as SAE Foundation Trustees Chair from 1998 to 2008. He now serves as an SAE Foundation Emeritus Trustee.



Dan and Vicky Hancock established a scholarship in their name in 2013, with the first one awarded in 2014.

In 2013, he decided to establish the scholarship because he wanted to "give back to the profession." He



Eric Constans, professor in the mechanical engineering department at Rose Hulman Institute of Technology, chairs the SAE Scholarship Selection Committee.

The 16 SAE Scholarships
BMW/SAE Engineering Scholarship
Dan and Vicky Hancock Scholarship for Mechanical Engineering Excellence
Donald and Barbara Mozley Scholarship
Edward D. Hendrickson/SAE Engineering Scholarship
Fred M. Young Sr./SAE Engineering Scholarship
Noble R. Patterson Scholarship
Ralph K. Hillquist Honorary SAE Scholarship
SAE/David Hermance Hybrid Technologies Scholarship
SAE Doctoral Engineering Scholarship
SAE/Ford Partnership for Advanced Studies Scholarship
SAE Heinz C. Prechter Award for Automotive Excellence
SAE Long Term Member Sponsored Scholarship
Tau Beta Pi/SAE Engineering Scholarship
TMC/SAE Donald D. Dawson Technical Scholarship
Toyota/SAE Engineering Scholarship for University of Kentucky students
Yanmar/SAE Scholarship

added that "when asking people and corporations to donate, it's really important to let them know all of your board is fully in support and fully contributing," he explained to *MOMENTUM*. Establishing the Dan and Vicky Hancock Scholarship for Mechanical Engineering Excellence was his way of expressing his commitment to the SAE Foundation.

As the title of the Hancock scholarship indicates, it is restricted to students majoring in mechanical engineering. Preference is given to students at Kettering University, where Hancock earned his bachelor's degree in ME back when it was called General Motors Institute. Kettering had, and still has, a co-op program with General Motors that functions, "in some sense," as a scholarship—specifically, the work component of the co-op provided students enough earned money to pay their tuition. At least it did in Hancock's day. "Today, that's no longer the case," he said. "The rate increase in tuition is far greater than rate of wage increase, and so Kettering students today need help."

Tuition is up all over, not just at Kettering, Hancock noted, making SAE scholarships more important than ever. "Tuition is quite expensive these days, and the scholarship helps. Mine doesn't give a full boat, but it helps a little bit."

Almost $30,000 has been awarded to students via the Hancock scholarship to date.

Although some scholarships are open to undergrad students in any year of study, some are restricted to certain years. The Edward. D. Hendrickson/SAE Engineering Scholarship, for example, is open only to incoming juniors and seniors.

"The Boler Company is proud of its efforts in funding the Edward D. Hendrickson/SAE Engineering Scholarship and working with the SAE Foundation to support the presentation of the scholarship to past and future student recipients pursuing engineering or related science degrees," said Brock Vander Veen, Manager of Technical and Legal Affairs at The Boler Company, which owns Hendrickson International. The scholarship is named after the son of the company, which was founded in 1913.

An SAE Scholarship Selection Committee of, typically, six volunteers from academia and industry assist SAE staff in selecting a recipient for each scholarship.

As students complete their application, the SAE staff is available to support the students, parents, and guidance counselors as questions might arise. An online platform simplifies the application process, allowing students to complete one universal application, as opposed to completing an application for each of the individual scholarships. Upon submitting their application, students are immediately informed of the scholarships they are eligible for. This user-friendly online system aids the SAE Scholarship Committee by generating a list of students to be evaluated for each scholarship.

Rose Hulman Institute of Technology professor Eric Constans chairs the committee. He'd served as faculty advisor for the Rowan University Baja SAE team from 2003 to 2018. Baja SAE is one of the SAE International student competitions funded in part by the SAE Foundation.

"Since the application process has gone entirely online, the number of applicants has increased dramatically," Constans told *MOMENTUM*. "In a given scholarship category, we may have several hundred applications. Working with Nicol Lachimia of SAE staff, I have developed a scoring rubric that takes into account GPA, SAT/ACT scores, school activities, and extracurricular activities. I'm especially looking for involvement in automotive activities, particularly for incoming freshmen. A student with a good GPA who has rebuilt a vehicle from the ground up will score higher than a student with a perfect GPA and no experience."

The review process can take about 15-30 minutes per applicant, Constans noted. "With the growing number of applicants, you can see that it's quite a time commitment." ■



Gustavo Eidji Camarinha Fujiwara said he is "humbled and honored to be the 2018-2019 recipient of the SAE Doctoral Engineering Scholarship."

SAE INTERNATIONAL

BENEFITS OVERVIEW

As an SAE Member, make sure you're taking advantage of everything we have to offer you, like:

- Technical Knowledge Benefits
  - The Member Connection
  - Publications
  - Spotlight on Design Videos
- Event and Training Benefits
- Partner Program Benefits and Savings
  - Personal and Business Benefits/Services
  - Insurance
  - Travel Services
- Member Career Tools and Resources
  - SAE Career Counselor Series
  - SAE Career Center
  - Biennial Salary Study and Calculator
  - Award and Recognition Programs
- Volunteer and Engagement Opportunities

DOSSIER: NICOLAS PARENT OF LION ELECTRIC CO.

THIS MONTH'S DOSSIER SUBJECT is Nicolas Parent, who works for Lion Electric Co., an electric vehicle OEM in Saint-Jerome, near Montreal. He started as an intern back in January 2017, bringing with him his Formula Student experience designing and building vehicles. He enjoyed his internship experience, where his responsibilities led to him being hired as Lead Suspension Designer in the R&D team for future vehicles. He is also in charge of the heating, ventilation and A/C, as well as vehicle packaging. He helps in chassis structural designs and is responsible for prototype builds.

Nicolas graduated from École de Technologie Supérieure (ETS) in Montreal, finishing his bachelor's degree in mechanical engineering in September 2017 after what he says was a "pretty long time (six years) dedicating my studies to Formula Student." He added, "What was supposed to be a four-year program ended up two years longer. It cost me a lot of sleep and money, but it was all worth it."

This February, Nicolas answered the following questions from *MOMENTUM*.

Why did you decide to become an engineer?
I decided to be an engineer when I was a kid. Back when most people wanted to become doctors, policemen, or firefighters, I wanted to design cars. I have always loved solving problems, thinking of solutions, and thinking about the future, and engineering seemed to be the way to go. I have always been a technological geek, and the automotive industry is a domain which is constantly evolving towards new technologies, and I hoped to be part of this one day.



At the unveiling ceremony for the 2017 Formula ETS prototype.


During the Design Event at Formula SAE Michigan 2017, Nicolas Parent (right) describes an acceleration model that his Formula ETS Student team developed.

To what character traits do you attribute your success?
I'd say mostly perseverance and dedication to my passions. I've always been a rational person, except for my involvement and dedication to projects that truly motivate me, like Formula Student did. I always kept pushing myself to the limit to achieve my goals as an engineer and our goals as a Formula Student team. This also meant not going to class and needing to learn all my classes a week before exams, which is not that rational when you take a step back, haha.

Of what accomplishment are you most proud?
I must say that my most proud accomplishment has to be winning the Design Finals at FSAE Michigan in 2014 and 2015 with my teammates. The amount of effort put into the project—the all-nighters, the stress—all of this becomes worth it when you step in front to get your trophy, even if it's not the trophy for Overall win. I am basically proud of every car I managed to work on from 2012 to 2017.

What is the most interesting project that you are working on at the moment?
I am currently designing the suspension system for an all-electric minibus, which is set to begin production in mid-2019. We built a prototype bus to test and validate all our systems and are presently updating designs for



Team picture, Michigan International Speedway, Formula SAE Michigan 2017.

production. The suspension system on this vehicle is particular, mostly because of the vehicle's low floor and center-mounted battery packs, leaving very little space for the suspension. It has dynamically adaptive ride behavior, while also allowing the vehicle to lower itself to help people in and out easily.

Who most influenced you on your journey to becoming an engineer?
My father was the only person to really know and understand my dedication to the Formula Student project. He was the only one who knew I was putting all my time designing and building a racecar instead of studying or even showing up to class. I mention Formula Student before "professional engineer" because I truly believe that this project gave me a purpose in life, and in engineering. I always knew I wanted to be an engineer, but when I visited ETS for the first time as a "pre-college" student and saw the Formula prototype car, I really knew that was what I wanted to do.

For how long have you been involved in SAE?
I was a member of the Formula Student team at my school, ETS Montreal, mostly involved in powertrain and drivetrain, but helping in pretty much every aspect of the project. From team management and treasury to mechanical design, through composite manufacturing and shop work, I've touched pretty much every aspect of my "future-to-be-engineer-life" with the Formula ETS team. Having to deal with team partners, suppliers, sponsors, deadlines, budgets, and learning stuff you don't see in class to manage to design, build, and compete with a vehicle, all this in one year, is a pretty extreme but effective way of learning to be an engineer.

Why did you decide to continue your SAE Membership beyond college?
I became an SAE Professional Member mostly because of the advantages, especially for books and technical papers.



The ETS Formula Student team placed first in the Design Event at Formula North 2015.

What is your favorite thing to do outside of work?
Watchmaking is my new favorite hobby, as it involves mechanics, on a much smaller scale, lots of precision, and an incredible amount of engineering/technical problems to solve. I've been designing a diver's watch in my spare time, and the technicality of the project is pushing me to design other watches afterwards, maybe even start a business later on if I want. ■

ADVERTISE YOUR INTERESTS

Ferris State University professor Patrick English wasn't envisioning a career as a professor in automotive engineering technologies when as a curious teenager in Williamsport, Penn., he asked a man about an old Jaguar behind his farmhouse. All he envisioned was restoring a classic car, for fun. He just had to ask about the Jag. Not long after that encounter, the 15-year-old English found himself working for the man in his classic car restoration shop.

Now he's a Ph.D. at university. Life might have turned out much different had he been too shy to let his intention be known.

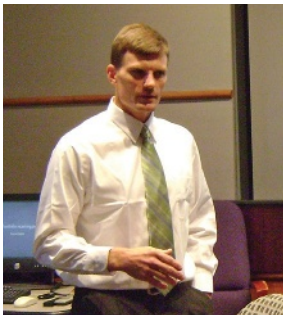
English has no regrets. And he doesn't want students in his Automotive Engineering Technology program—or any other student anywhere, for that matter—to live with regrets. Key to living a regret-free professional life is to advertise your interests to others.

"Be proactive and seek out what you're interested in, wherever it's at, and make contact with people that are doing what you're interested in," he told *MOMENTUM*. "Sometimes it leads to opportunities that otherwise wouldn't exist, or it leads to opportunities for learning. For me, it opened a door I didn't know existed."

Be specific in expressing your interests and goals.

"If you put out there what your goal is—and certainly you should have a specific goal—people will help you achieve it if you are serious about it," he said. For many people, it's a natural impulse to help others realize their goals and dreams. "People will say, 'You know, I was talking to this guy and he's working in the field you are interested in. Is it ok if I give him your email address?' So be unashamed in talking about where you want to get in life; other people will help you get there."

English noted that the SAE Collegiate Design Series, with its many student competitions in various sectors of mobility, is populated by professional engineers who volunteer their time not primarily to make the competitions successful, although that's part of it. More important for the volunteer-professionals is helping the student engineers realize their full career potential. "These professional engineers have an altruistic impulse that students would be wise to take advantage of," he said.



Dr. Patrick English is in his 14th year teaching at Ferris State University.

Another career tip is to use snail-mail. English said it's all too easy for email communications to get deleted or forgotten. A letter mailed in a physical envelope will boldly stand out.

A few other bits of advice from English include getting enough sleep and cutting back on social media and other distractions. And be sure to exercise: "I do my best thinking when I'm running," he said. ■

TAKE IT FROM THE EXPERTS

You're used to the classroom and the lecture hall, listening to your professors and taking notes. But there is no substitute for discussion and collaboration with current industry experts and professionals.

SAE International offers a host of such experts for you to invite to your collegiate chapter, at no cost to you. The visit can take any shape that will fit your chapter's needs and interests, whether it's a lecture hall presentation or a tour of your lab and SAE Collegiate Design Series vehicle. SAE Membership and the Industrial Lecture Series are here to help prepare you for the current and future mobility industry.

Funding for the free lectures is via the SAE Ralph R. Teetor Educational Award program.

"This is incredibly valuable for our team members," Scott Fjordbotten, captain of the Formula UBC Team in Vancouver, BC, said of the Industrial Lecture Series. "The program allows us to learn from experts in the field, both educating our members and inspiring them to learn more about the opportunities in the industry."

The method of learning through the Industrial Lecture Series makes information relatable and immediately applicable, thus easier to absorb.

One such expert, Steve Fox, brings nearly 40 years of experience in the motorsports field, and has been volunteering with SAE for almost 20 years, first as a Formula SAE (FSAE) design judge, then chief design judge, and then Industrial Lecture Series presenter. His lectures primarily target students participating in the SAE Collegiate Design Series. To him, FSAE is the most intense engineering educational program. "There truly is no substitute for a college engineering student rolling up his (her) sleeves and machining, assembling, testing, driving, and/or breaking something they personally brought to life from their CAD screen," said Fox. "SAE's Industrial Lecture Program is simply another tool that students can take advantage of to further their understanding of the subject, if they will just send the e-mail request."



SAE Industrial Lecture Series presenter Steve Fox has nearly 40 years of experience in the motorsports field.

Review the list of speakers at sae.org/participate/membership/collegiate-chapters/industrial-lecture-program?tab=3 and reach out to Corey Dillon, Member Relations Specialist (corey.dillon@sae.org), to get connected with one of them. ■

By Corey Dillon, SAE Member Relations Specialist

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