CELEBRATING PROFESSOR WILLIAM DUFF’S CONTRIBUTIONS AND DEDICATION

Professor William Duff with International Energy Agency colleagues at the Philips Research Laboratories in the Netherlands.

It has been more than 44 years since Professor William S. Duff first set foot onto Colorado State University’s campus. He came to the department as part of the newly established industrial engineering program, ultimately introducing and teaching 15 different industrial engineering and operations research courses.

In April, the department celebrated Professor Duff’s retirement – reminiscing over his numerous research accomplishments, prestigious recognitions, and exceptional loyalty and dedication to the department. During his time here, he has not only witnessed incredible growth and development within the mechanical engineering department, but also contributed to the program’s current success.

“I experienced the department’s progression from a division, but entertaining group of individuals in my first few years, later, to a very congenial and capable group of colleagues; and finally, to one of the most productive departments in the University.”

PROFESSOR DUFF’S NOTABLE ACCOMPLISHMENTS INCLUDE:

+ Chairing the College of Engineering Systems and Optimization Committee for more than 20 years.
+ Patenting technology in the solar energy field during a three-year appointment as a visiting scholar at the University of Chicago Department of Physics Enrico Fermi Institute.
+ Managing and participating in a 13-country International Energy Agency research program that was responsible for major advances in solar thermal energy collectors and systems.
+ Authoring one of the decade’s best journal papers in optics.
+ Providing key materials research contributions to a Department of Energy Metal Oxide Semiconductor photovoltaics project.
+ Leading the department’s industrial engineering and operations research program since 1979.
+ Being the first CSU faculty member to restructure and deliver a core curriculum engineering course fully online.
+ Serving six years on the University Committee on Teaching and Learning where he developed and implemented the registrar’s current approach for determining Graduation with Distinction and played a key role in the implementation of our first comprehensive University Honor Code.

Before CSU, Professor Duff was an industrial engineering and operations research Ph.D. student at Stanford University and a researcher at the Stanford Research Institute. Prior to that, he worked as a management trainee and industrial engineering department analyst at U.S. Steel.

After retiring, in addition to spending more time with family and friends, Professor Duff looks forward to developing nascent hobbies, continuing some teaching, and providing solar energy consulting.

When asked what he’ll miss the most, he said, “My Ph.D. students and their research, the exceptional, intelligent, motivated and capable student; students who may not have been so gifted but were very motivated and willing to work hard to learn, working individually with many dedicated faculty and staff, and working with the current department head and some of our former exceptional department heads.”

Department Head Sue James concluded, “It’s very hard to capture Professor Duff’s contributions to the department in just a few words. He has been the face of our Industrial Engineering and Operations Research program for several decades – educating hundreds of graduate students and making us known around the world for IEOR. He was one of the early trailblazers in distance education at CSU and has graduated more Ph.D. students at a distance than any other faculty member. His decades of loyal service and manifold contributions will live on in the department for many decades to come.”

Congratulations, and best wishes on your retirement, Professor Duff!
HEAR ... WITH YOUR TONGUE?

Mechanical engineering Associate Professor John Williams is on the verge of a major medical breakthrough that over the last few months has captured a frenzy of media attention from all over the country. Professor Williams and his team are working on a revolutionary device to assist the hearing impaired, allowing sound to be processed through the tongue, instead of the ear.

Typically, the hearing impaired would use a hearing aid to amplify sound or a surgically implanted cochlear implant to stimulate the auditory nerve. Depending on the severity of the case, this new device would eliminate surgery, be significantly less expensive, and be just as effective in aiding those who have hearing loss.

“Cochlear implants can be upwards of $40,000, and including training can be even more expensive,” Professor Williams said. “What we’re shooting for is something in the few thousands of dollars that could work as good or even better.” Other drawbacks to having cochlear implants is the inherently risky procedure, the additional damage they can cause to the inner ear, and candidates must have most of their auditory system intact for the implants to do their job.

So, how does the new device work? Users push their tongues against a retainer-like mouthpiece packed with tiny electrodes to feel a pattern of Bluetooth-enabled, electric vibrations. The brain can be trained to translate these vibrations into words, just as a cochlear implant would work with the auditory nerve.

“We’re taking and substituting touch on the tongue with signals that the brain could use and substitute for hearing,” Professor Williams said.

The tongue is a fascinating organ, containing thousands of taste buds that connect to nerves running into the brain. This area of the brain is capable of decoding complex information, and this is what led him to his new research project.

So, how did Professor Williams come up with the idea for this brilliant device? After spending most of his career designing systems for space travel for NASA, he found a new concentration after his obstacles in space travel were overcome. Neuroscience and sensory substitution sparked his interest, especially after he himself developed tinnitus — a constant ringing in the ear.

After a year of designing and testing this device, Professor Williams and CSU graduate student, JJ Moritz, realized its promising potential and filed for a provisional patent and also launched Sepian LLC, to bring the technology to new heights.

They have partnered with Assistant Professor Leslie Stone-Roy of the College of Veterinary Medicine and Biomedical Sciences, to dive deeper into how an adult brain would adapt to this unique type of technology.

“We have a remarkable amount of plasticity in our brain, even as adults,” Professor Stone-Roy said. “We now know that it is able to make changes and adapt to changes in incoming information, especially stimuli, that are of importance to the individual.”

Together, they have launched a study to determine where the device would need to be placed on the tongue to maximize its effectiveness. “Basically, we are mapping the nerves on the tongue,” Professor Stone-Roy said. “There isn’t a lot of information out there about the nerves on the tongue and their ability to sense electrical impulses.”

Understanding how the tongue receives these messages, will not only enhance the device but determine whether standardized or customized mouthpieces are needed, which will in turn help determine cost of the device.

Professor Williams notes that it could take up to two years before the device is available for public use.

FROM THE DEPARTMENT HEAD

Dear Friends,

I want to thank you for taking the time to read our mechanical engineering newsletters. We take pride in our exceptional students, faculty and the impactful projects they are involved with; and we enjoy sharing our progress and breakthroughs with our supporters — you!

In this issue, we are delighted to welcome four new faculty members, Drs. John Petro, Kimberly Catton, Shantanu Jathar, and John Volckens. We also highlight one of our longest-running senior design projects, extraordinary grants our faculty have received over the past year, courses that are sparking creativity in the minds of our undergraduate students, and last but not least, the retirements of adviser extraordinaire, Chriselda Engel, and Professor William Duff, who has dedicated 44 years to the department!

If you’re reading this from New York or Pennsylvania, I have plans to travel there later this year to meet alumni and personally thank some of our donors, and would love to catch up over coffee. Feel free to reach out to meupdates@colostate.edu.

Thank you, again, for your continued support. It is because of you that we have such exciting developments to share. As always, I look forward to hearing from you; please keep in touch!

Cheers,
Sue James
**OUR NEW FACULTY**

**DR. JOHN PETRO** joined the mechanical engineering department as a professor of practice. He has worked for more than 20 years in the tooling, special machines, robotic welding, and cutting industries. He is also an American Welding Society certified welding inspector.

Prior to teaching at CSU, he taught mechanical engineering and welding courses for nine years at the University of Wisconsin-Stout while living in Colorado. He is a native of Wisconsin, where he received a B.S. in mechanical engineering technology from the University of Wisconsin-Parkside and an M.S. in mechanical engineering from the University of Wisconsin-Madison. After moving to Colorado with his family, he received his Ph.D. in mechanical engineering from Colorado State University. In his spare time, Dr. Petro enjoys hiking, skiing, golf, and playing the card game Sheephead.

**DR. SHANTANU JATHAR** joined the mechanical engineering department as an assistant professor. He has a Ph.D. from Carnegie Mellon University where he used numerical models and laboratory experiments to understand the atmospheric formation of organic aerosols from combustion sources such as cars, trucks, aircraft, and wildfires. He worked as a post-doctoral scholar at the University of California-Davis, where he was funded by the California Air Resources Board to improve the treatment of particulate matter in air-quality models used for regulatory purposes. His research interests lie at the intersection of energy and the environment, by leveraging laboratory experiments and regional/global air-quality models, he intends to study the atmospheric evolution and properties of air pollutants arising from energy systems, all in the interest of addressing future energy and environmental policy. Dr. Jathar hails from the suburbs of Mumbai, India. He and his wife, Puova, are enjoying parenthood with their toddler, Vedant, and, in his spare time, he likes to run, bike, sip coffee, and play the bansuri (bamboo flute).

**DR. KIMBERLY CATTON** joined the mechanical engineering department as a professor of practice. She has been teaching in universities since 2008, when she received her Ph.D. in experimental fluid mechanics from the Georgia Institute of Technology. Dr. Catton worked in water consulting for several years prior to obtaining her doctorate and has a professional engineering license in hydraulics.

Dr. Catton’s current research interests include: (1) geographical assessments of the environmental impacts associated with algae-based biofuels, (2) statistical water quantity and quality tools to assess the environmental impacts of hydraulic fracturing, and (3) statistical assessment of the interactions between toxins in water and biological and physical conditions.

Dr. Catton is also working on research in the field of education with a particular interest in aligning practical experience with the undergraduate curriculum. When Dr. Catton isn’t teaching, she enjoys hiking, swimming, and learning the violin with her two children, Dean and Vivienne.

**DR. JOHN VOLCKENS** joined the mechanical engineering department as an associate professor. He also directs the Center for Energy Development and Health within the Energy Institute at Colorado State University. His research interests involve combustion science, aerosol technology, and air pollution-related disease. He earned a B.S. in civil/environmental engineering from the University of Vermont in 1996 and an M.S. and a Ph.D. from the University of North Carolina at Chapel Hill in 1999 and 2003, respectively. He then went on to a postdoctoral position at the U.S. EPA’s National Exposure Research Laboratory in Research Triangle Park, N.C.

In 2004, he joined the faculty of environmental and radiological health sciences at CSU, where he still holds a courtesy appointment. At CSU, he pioneered the development of several new sensor technologies – resulting in two recent patent applications.

He and his wife, Amy, enjoy living in Old Town Fort Collins (and the adventures that come with living in a 123-year-old house!), and recently celebrated the birth of their first child, Josephine, in 2014.

**BON VOYAGE, CHRISELDA!**

As we welcomed new faculty into the department, we also celebrated the retirement of dedicated mechanical engineering undergraduate student adviser, Chriselda Engel, who spent the past eight years guiding and supporting thousands of undergraduate mechanical engineering students as they progressed through the program.

Jennifer Vaughn, current graduate student and former undergrad, wanted Engel to have a departing gift she would never forget. She started a fundraiser allowing mechanical engineering students, faculty, and staff to fund a well-deserved dream vacation for Engel and her husband. More than 100 people donated, and $4,825 was raised! The couple have made plans for an Italian getaway this summer!

**SHARE YOUR NEWS!**

We enjoy hearing from our alumni. Please help us celebrate your personal and professional accomplishments.

SEND YOUR UPDATE TO: meupdates@engr.colostate.edu
2006 ME GRADUATE NAMED WOODROW WILSON OHIO TEACHING FELLOW

We are proud to announce that 2006 mechanical engineering graduate, John Beck, was recently named a Woodrow Wilson Ohio Teaching Fellow. He was one of nearly 80 candidates selected for this fellowship, which recruits only the most qualified STEM (science, technology, engineering, mathematics) candidates to teach math and science in high-need public schools.

By committing to at least three years of service after training, the fellows receive a $30,000 stipend to support themselves during the intensive first year of local classroom experience and graduate education at the University of Akron.

“I see a great need for teachers who have a deep passion for their content, especially in math. Too many students feel disconnected, sometimes even humiliated, by an arithmentric approach to understanding mathematics. I want to awaken them to its beauty, its simplicity, its power,” said Beck.

Before being selected for this fellowship, Beck taught in Baltimore, Md., and worked in the manufacturing sector. He is an active volunteer in his local community and amateur musician.

Congratulations, John!

The Woodrow Wilson National Fellowship Foundation administers this program in five different states, is based in Princeton, N.J., and is funded with the support of the state of Ohio through the Office of the Board of Regents of Higher Education. For more information about the program, visit www.woodrow.org/Ohio.

SENIOR DESIGN: FORMULA SAE’S FIRST ELECTRIC VEHICLE

Start your engines! This year’s Formula SAE – Ram Racing team is bringing something new to the speedway: an electric vehicle with a need for speed. In June, team members are hoping to achieve a top 10 finish at the national Intercollegiate Design Competition in Nebraska. They will present at CSU E-Days, as well.

All previous models have been internal combustion vehicles using E85 ethanol, so the challenge was to build an electric motor to outdo previous models’ performance – and to complete it in one year. This talented and dedicated group of mechanical engineering and electrical engineering seniors joined forces on this new concept – overcoming both electrical and mechanical challenges.

The electric motor is powered by a 144 lithium cobalt oxide battery with a max 300 volt DC. It operates at 80 kilowatts max power, has about 236 lb-ft of torque at the crank and a 41 gear reduction through the chain drive. 944 lb-ft of torque is available at the wheels. The total weight of the vehicle is 625 pounds, which is fair for the first model of its kind at CSU.

The generosity of a variety of sponsors has played a huge role in the elaborate concept of this electric vehicle. Larger and long-term sponsors include: Woodward, Lenovo, Melasta Batteries, Remy Motors, HMS Motorsports, 3R Automotive, SRAM, PTC, Colorado Waterjet, and Pioneer Engineering. Other local businesses and private parties, including team members’ families, have also been extremely supportive. The team has received $15,000 in cash and between $80,000 and $100,000 in in-kind donations over the last two years.

Other team supporters include Ram Racing, an undergraduate student organization, initiated in 1996. Club members generally meet twice a week and dedicate as much of their spare time and energy as possible into designing, building, and racing the Formula SAE vehicle.

The Intercollegiate Design Competition involves SAE teams from six continents. It was started in 1980 by engineers and automotive engineers as a way for students to participate in a Mini Indy race series. We wish Ram Racing best of luck at this national competition in June!
PROFESSOR MARCHESI'S $1.9M EDF STUDY

The Environmental Defense Fund and industry partners have poured millions of dollars into investigating methane emissions from the U.S. natural gas industry over the past few years, and the results could have the potential of significantly influencing the Environmental Protection Agency into changing its emissions regulations.

Anthony Marchese, mechanical engineering associate professor and director of the CSU Engines and Energy Conversion Laboratory, led a $1.9 million EDF study that assessed emissions from gathering and processing facilities, which are potentially major sources of methane emissions.

EDF’s overall goal is to quantify the amount of methane leaking into the atmosphere from the natural gas supply chain. Identification of the sources of methane emissions will suggest the measures that can be taken to reduce future emissions. Currently, the net leakage rate in this sector is not well known, which poses a problem when understanding its effects. If any, to global warming, human health, and society.

On an intense timeline, from October 2013 to April 2014, Professor Marchese and his team collected and assessed data from 114 gathering facilities and 16 processing plants across 13 states to determine if methane leakage occurred at higher rates than anticipated. Other sectors, also supported by the EDF, evaluated other phases of the supply chain process. “This is an exciting study because it is, by far, the largest and most comprehensive data set ever collected on direct methane emissions from the gathering sector,” Professor Marchese said.

The results determined that 30 percent of the gathering facilities accounted for 80 percent of the methane emissions measured, and methane loss rates at processing plants were much lower than that at gathering facilities. Professor Marchese noted that, “Processing plants are generally much larger and permanently staffed, and are required to report methane emissions to the EPA. They are also required by federal law to repair any leaks within five days of detection. Most gathering facilities aren’t subject to those federal regulations.”

With this knowledge, Professor Marchese believes that the EPA will reevaluate the need to regulate methane emissions in gathering facilities, just as they do in processing facilities, to eliminate higher loss rates.

Once the results are captured from all 16 of EDF’s emissions studies, a more accurate estimation of how much methane is actually being released into the atmosphere via the natural gas supply chain will be published. Professor Marchese and his team are currently completing a publication on a Monte Carlo simulation that uses the methane measurement results to estimate the total methane emissions from all U.S. gathering and processing facilities. However, a large chunk of data is still missing — leakage from the hundreds of thousands of miles of gathering pipelines that lie between the wells and the gathering facilities.

Stay tuned for up-to-date information on this developing research.

PROFESSOR VOLCKENS RESEARCHES COOKSTOVE POLLUTION WITH $2.8M GRANT

Mechanical engineering professor John Volckens, was recently awarded a $2.8 million grant from the National Institutes of Health to study the emissions and health effects of air pollution from cookstoves. The research team led by Professor Volckens and co-PI Professor Jennifer Peep, will examine the hypothesis that cleaner-burning stoves will improve the health of people who use them.

The first phase of this five-year study will take place at CSU’s Powerhouse and will shed light on the type of toxic compounds that are released from the combustion of wood, charcoal, and other biomass fuels. Understanding what these emissions are composed of is crucial, as this aspect of the study is poorly understood. This information will not only assist in developing improved stove design but is critical in understanding how human health is affected.

The second phase includes recruiting volunteers to inhale wood smoke and measuring short-term markers of cardiorespiratory health just hours after exposure. For study volunteers, this controlled exposure study will be equivalent to spending a couple hours around a campfire — an activity that is very similar to those who use cookstoves on a daily basis around the globe.

This research will take place in a human exposure chamber that was built by a mechanical engineering senior design team over the course of two semesters. The construction of the chamber, which is basically a walk-in cooler, has a variety of safeguards in place.

“Our team works really well together, something we are extremely grateful for as teams were created without our direct input. We’ve been able to accomplish a lot to date and will produce a final product that we will be proud of,” said team member Jaime Urban.

Dr. Christian L’Orange who is assisting Professor Volckens in leading this senior design project, said, “One of the amazing things about this project specifically, and the work conducted at the Center for Energy Development and Health in general, is the scale of the impact it could potentially have.”

Nearly 3 billion people, primarily the world’s poorest people, are using traditional, inefficient, and poorly ventilated indoor cookstoves. Implementing cleaner-burning stoves that are less polluting but affordable could potentially account for the largest benefit to human and environmental health since the development of distributed water sanitation systems in the previous century.

The biomass emissions exposure chamber is located at the Powerhouse.
PROFESSOR KHETANI RECEIVES CAREER AWARD FURTHERING MINIATURE LIVER RESEARCH

Since earning the highly prestigious NSF CAREER Award from the National Science Foundation last year, mechanical engineering Assistant Professor Salman Khetani and his students have made a breakthrough in drug testing research on two fronts: engineering a mini human liver using stem cell-derived human liver cells from patients and using the mini liver to screen potentially toxic drugs.

Currently, the Food and Drug Administration requires new drugs to undergo animal testing (e.g., in rats) as part of the preclinical screening process prior to initiation of human clinical trials; however, animal testing doesn’t fully represent the human condition due to evolutionary differences in animal and human liver functions – decreasing the credibility of the results. Animals are less than 50 percent predictive of human drug-induced liver injury, which remains a leading cause of drug failures in both preclinical testing and in the broader marketplace.

Utilizing primary human liver cells from donor organs or derived from a patient’s stem cells for drug testing could potentially avoid these discrepancies; however, these cells rapidly lose their in vivo (in the body) functions when transferred to a conventional culture dish in vitro (literally “in glass”, i.e., outside the body). Furthermore, the stem cell-derived human liver cells or hepatocytes lack the functional maturity of adult primary cells. To address this issue, the Khetani Lab is utilizing microfabrication tools adapted from the semiconductor (microchip) industry to engineer a mini human liver mimic.

Perfecting the culture system that these cells live in outside of the body is an opportunity the Khetani Lab is exploring. Currently, the team is engineering the next generation of novel microfluidic devices (with funding from the NSF CAREER award) in which the liver cells and their supportive cell neighbors are perfused with liquid that mimics properties of human blood in order to allow cells to function as close to in vivo as possible.

Design of these devices relies not only on mechanical engineering (i.e., fluid mechanics) principles, but also microfabrication tools adapted from the semiconductor industry (i.e., electrical engineering). Thus, their research utilizes tools from biology, electrical engineering, and mechanical engineering to create optimal platforms that allow human liver cells to be used in vitro for the applications they are targeting.

The Khetani Lab has also made huge strides in terms of capturing drug testing results in the engineered human liver mimic. The liver mimic has a 65 percent accuracy rate (relative to human clinical studies) while animal testing has a 40 percent to 50 percent accuracy rate. Drug testing on primary human liver cells has a 70 percent accuracy rate, proving that with more research the stem cell-derived liver mimic could eventually perform just as well, if not better, providing an entirely unlimited/sustainable and high-throughput drug testing method in the future, and using fewer animals in research. Ultimately, patient-specific stem cells can usher in a new era of personalized drug testing: medicine and the platforms the Khetani Lab is engineering will help accelerate the process.
MECHATRONICS GROUP PROJECT EARNs “2015 GADGET OF THE YEAR” FROM DESIGN NEWS MAGAZINE

The DDV-IP, or Drink Deliver Vehicle – Inverted Pendulum, started out as an audacious undertaking, but this MECH 307 group was thirsty for a challenge, and it paid off! Students Doug Swift, Tyler Reddy, Rob Harvey, and Michael Habel weren’t sure they could pull it off as the skills and software required were complicated – but the team was determined.

The course, taught by Associate Professor David Aciatore, didn’t require that all groups work on the same project, giving students the opportunity to conceptualize a unique device. “There was a group of us and we had to incorporate six different features, including items such as an Arduino, manual input, drivers, motors, and sensors,” said Swift. “Other than that, it was freeform.”

The dedicated team spent more than four months designing and building the device. Harvey came up with the concept during a brainstorm session, and Habel did the majority of the coding. “The most difficult part was getting the control system to work. None of us had the experience in control systems. We could see the logic, but it took trial and error to get it to work,” said Harvey.

The concept is a two-wheeled, self-balancing robot controlled by a wireless RF remote and fit with a fancy LED-Ill serving tray. With the title, “2015 Gadget of the Year,” the team received $6,000! They soon went on to present at the Pacific Design & Manufacturing event in Anaheim, Calif., in February.

Unfortunately, two weeks after the project was complete, Habel died unexpectedly. “We came out of this learning a lot, and we attribute that to Michael,” said Swift. “We worked together very well, and that made the project possible.”

This piece is in memory of Michael Habel, who passed away unexpectedly in June 2014.

MECH 202: ENGINEER DESIGN II

Instructor Bert Vermeulen incorporates real-world situations into his MECH 202 class – inspiring his students to learn with purpose and have fun in the process!

In August 2010, 33 Chilean miners became trapped 2,300 feet underground after the mine they were working in tragically collapsed. For 69 days, the men struggled to stay alive. Vermeulen brought this event into the classroom and presented it as an opportunity to his students.

The assignment was to build a vehicle to theoretically rescue the miners from the collapsed mine, however, a few variables were different. The vehicle would be traveling horizontally, and the miners were Ping-Pong balls with smiley faces drawn on them.

For six weeks, 18 teams of students, worked on their rescue vehicles.

“Different teams approached the problem differently. Some immediately fabricated something and tested it, others spent time analyzing and sketching concepts, and others saw this as an opportunity to learn how to program a microcontroller,” Vermeulen observed.

This semester, the assignment is modeled after Philae, the device that made a rough landing on Comet 67P last fall. The goal is to safely land a Ping-Pong ball into the space of a CSU Rams license plate frame, within a 30-second timeframe.

CSU ASME CELEBRATED 100 YEARS (CONTINUED FROM PAGE 1)

scales of turbulence with the use of a local Reynolds’s Number – a novel statistical approach to modeling fluid dynamics.

However, undergraduate student and ASME president, Jeff Fisher, stole the show as he reflected on the journey that led him to mechanical engineering, looking to both the past and future societal contributions of mechanical engineers. The evening concluded with a message from Department Head Sue Jannes, when she shared how proud and honored she is to be a part of the department. She asked the audience to attend the bicentennial celebration, complements of a senior design team’s time machine. She also predicted that 3-D printers would have printed all event décor and the best faculty would’ve been cloned to celebrate ASME, 100 years from now.
TOHNS ROLL ROLL
JUNE 19, 2014-MARCH 31, 2015

Every effort has been made to ensure the accuracy of this donor honor roll. We sincerely apologize for misspellings or omissions of names. We appreciate the opportunity to correct our records. Please advise us of errors by calling (970) 491-0924 or by e-mailing give2enrg@engr.colostate.edu.

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