

# Perfecting a Greener, Cleaner Future Vehicle

BY KALENE MCCORT



photo by Tom Kimmel

by intricate scale model trains and by college he had teamed up with other model enthusiasts to help recreate about half of Colorado's Rio Grande Southern railroad, as it looked in the summer of 1940.

"Model train layouts have a lot of electronics in them. There are lighting effects, sound effects, and very sophisticated controls that involve cramming tiny computer chips and circuits inside of the locomotives to enable operating multiple trains on the same set of track," said Plett. "I got my first hands-on experience with electronics at that point, which was a significant factor in my choosing to study engineering."

Currently, most of Plett's research takes place in UCCS's High Capacity Battery Research and Test Laboratory. Built in 2010, this 540-square-foot space was made possible with support from the National Science Foundation under the Major Research Instrumentation Program. In this lab, Plett works to uncover the research that will make electric cars the automotive travel choice for the general public.

"The biggest issue relating to consumer acceptance of electric vehicles has to do with economics," said Plett, who believes electric cars are quieter, cleaner and require less maintenance. "Automotive battery cells and packs need to be made less expensive, and battery packs need to have demonstrated life that matches the life of the vehicle."

Plett acknowledges that for the average personal driver electric vehicles may not currently be the most economically sound. However, when they are used as delivery trucks and shuttle buses, they are much more cost effective.

"The operating costs of electric vehicles, even now, are about half of the operating costs of gasoline/diesel powered alternatives," he said. "This will only continue to favor EV in the future as fuel costs climb."

"Most of our work at this point involves developing mathematical models of how lithium-ion battery cells behave and age. This requires the ability to generate a lot of data, from which we can postulate models and then verify whether they make sense. Looking forward, we will be developing control algorithms to optimize battery performance; so we will need to be able to test these algorithms in realistic scenarios."

According to Plett, today's hybrid electric vehicles use only a small percentage of their full energy storage capacity range.

"Our main research goals have to do with developing a better specific understanding of how lithium-ion battery cells degrade, and devising control methods for charging and using

We are draining our earth's resources every time we jump in our four-door and hit the gas pedal. UCCS professor of engineering Gregory Plett is working to ensure the effectiveness of electric cars to sustain our environment and strengthen our wallets.

"I've always liked to build things," said Plett, who now holds 19 patents. "I suppose that this started with wooden blocks, but quickly moved on to LEGO and Erector sets."

As he got a bit older, the basic building blocks were replaced

the batteries so that we can maximize vehicle performance while still minimizing degradation," he said. "We envision that this will allow us to safely use more of the battery's full capacity, resulting in the ability to use a smaller battery pack for the same vehicle range. Smaller battery packs result in lower price - so there is strong incentive to work in this particular area of study."

As a man who has had much success in his field, Plett encourages students to forge ahead, no matter what challenges arise along the way.

"The skills and knowledge that must be mastered to become an engineer are not easy to learn, but if someone is interested in applying math and science to solving problems that can often really improve people's lives in some way, they ought to stick with it."

"Teaching for me is a true joy. It's the icing on the cake," said Plett. "Even the research I do, I consider to be teaching."

Having a vast understanding that individuals grasp knowledge through different methods, Plett has incorporated the practice of lecture capture, the video recording of a presentation, as a significant aid in his teaching practices. In-class students can revisit and replay parts of the lecture they didn't grasp, and for those who may have missed the class- it is like they never did.

"For my specialty area in control-systems engineering, lecture capture allows two faculty members to offer eight specialty depth graduate courses on-demand so that students can obtain a comprehensive focused degree without the need for the faculty resources that only the largest schools can offer."

"Students perceive and assimilate academic content differently, so I believe that instruction needs to be balanced in ways to reach, reinforce, and challenge all students," he said.

Down the line, Plett would love to see lecture capture be packaged as a tool for esteemed professors to reach enthused students all over the world. To see a library of DVDs containing words of wisdom, being used like living textbooks, Plett considers a "utopian dream."

"If this dream were to be realized, it could be very resource efficient and of great value to the student," he said, "Imagine



being able to take a course today that was originally taught by Einstein!"

"I really enjoy learning new things, then grappling with how to present them to others, then developing the materials to do so, and teaching the course," said Plett, who joined the faculty in 1998. "I've developed and taught more than one distinct new course every year that I've been at UCCS."

When not creating algorithms to optimize battery life, Plett enjoys belting it out and has let his bass tone shine, as a member of Stanford University's "Testimony" Christian a cappella group. He even contributed to their debut CD recording "Gone Fishin'". A man of strong faith, he dedicates his Sundays to teaching an adult class at a local church.

Plett enjoys his weekly ritual of ordering take-out food, and watching a movie with his wife and three daughters. At home he becomes inspired to reinvent household items- a true reflection of an engineer and someone who cares a great deal about our resources. "My most recent project was to build two end tables of my own design from redwood recycled from a former deck, and slate tile leftover from finishing our basement a few years ago," said Plett.

Automotive battery cells and packs need to be made less expensive, and battery packs need to have demonstrated life that matches the life of the vehicle.