THE EYE TEAM

A physics alumnus partners with NC State mathematics researchers to improve ocular imaging.

Bioptigen has an ambitious goal: create systems and software capable of rendering ultra-accurate three-dimensional images of the entire eye.

The process is technically daunting, in part because eyes are tremendously complex and highly variable from one person to another. But the benefits of the technology — improved vision for millions of people with various eye conditions — could be life-changing on a grand scale.

"We need to be able to measure things that just have not been measured before," said Dr. Eric Buckland, an NC State physics alumnus who is the Triangle-based company's co-founder and CEO. "And we need to do that precisely enough so that it's useful."

Like many technology companies, Bioptigen is focused on its products and market; it looks outside its walls for basic research. For this project, Bioptigen turned to NC State.

Today, thanks to the efforts of Dr. Mansoor Haider, a professor in the Department of Mathematics, Bioptigen is closer to getting those exact measurements than ever before. Haider and one of his Ph.D. students, Micaela Mendlow, have been developing intricate algorithms that will help the company make its three-dimensional eye imaging more accurate.

Haider wanted to partner with Buckland partly because his applied mathematics research in bioengineering has natural connections to Bioptigen's work. But Haider also had a personal stake in the project.

Years ago, Haider was diagnosed with keratoconus, a degenerative eye disease that over time causes the corneas to bulge into a cone-like shape. He received a corneal transplant for his condition after several years of being fitted with specialized contact lenses.

Haider is hopeful that more accurate scanners could help ophthalmologists identify diseases like keratoconus earlier in their development.

"The idea of our research is to make these 3D models of the entire eye more accurate and robust," he said.

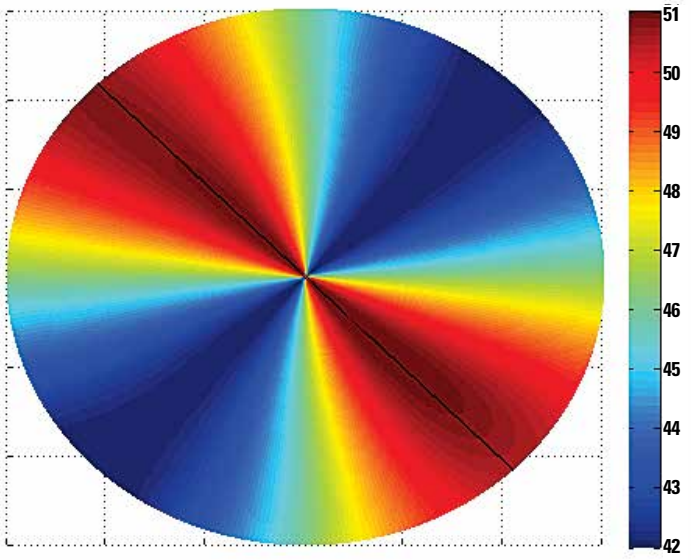
ACCESS FOR INDUSTRY

The College of Sciences hosted dozens of business and government representatives on campus in February for Access Day. The event was part of the College's commitment to boosting relationships with industry.

Access Day gave attendees opportunities to forge partnerships with College researchers and get help with tough scientific and technological problems. College faculty and graduate students presented nearly 50 projects covering health and well-being, energy and the environment, safety and security, and other research areas.

Speakers included Dr. Michael Pcolinski of BASF and Ed Mathers of New Enterprise Associates. Dr. Joseph DeSimone, a chemist and entrepreneur who holds faculty positions at NC State and UNC-Chapel Hill, gave the keynote address. Access Day was sponsored by BASF, LORD Corporation and the Kenan Institute for Engineering, Technology and Science.

"Feedback is valuable and can be hard to get," said Dr. Joshua Pierce, an assistant professor of chemistry who presented at the event. "Meet people, follow up and keep the conversation going — that's what Access Day is all about." □



NC State mathematicians are developing intricate algorithms to model the many features that distinguish individual eyes from one another. This "curvature map" of a simulated cornea was generated from those algorithms. The reds show the steepest areas, the blues the flattest.

MICAELA MENDLOW

Bioptigen specializes in a type of optical imaging known as Spectral Domain Optical Coherence Tomography. The technology enables simultaneous high-resolution imaging of multiple surfaces, such as the inside of the eye. Scanners produced by the company create unique, high-resolution eye representations that are used by ophthalmologists around the world.

The scanners work by rapidly acquiring a series of high resolution images of the eye that are compiled into a full three-dimensional picture. Segmentation algorithms identify boundaries of the various parts of the eye from these images, and then visual performance attributes of the eye can be computed.

But the current technology isn't able to account for all of the one-of-a-kind features that distinguish one eye from another. Among the missing components is a precise calculation of each eye's curvature.

"The computation for eye curvature is very sensitive to tiny differences in the segmentation process," Mendlow said. "Even tiny errors can completely throw off the result and create an inaccurate depiction of the real curvature. It's a really interesting problem, and it looks like no one has decided to tackle it."

In the future, the work could contribute to better designs of contact lenses and also lead to earlier and more accurate diagnoses of eye-related diseases such as keratoconus and astigmatism.

Buckland has been supporting the project through a grant to the Department of Mathematics Graduate Industrial Traineeship program. The program broadens traditional graduate education to include first-hand experience working with industry.

For Buckland, the partnership with Haider and Mendlow is not only an opportunity to help his company, but to maintain a connection with his alma mater.

"NC State formed the foundation of what I do today," Buckland said. "I really feel that this College is my family." □