

FACULTY FOCUS: Dr. Sos Agaian, Distinguished Professor of Computer Science

PICTURE PERFECT: ENHANCING PICTURES AND ENCOURAGING STUDENTS



Journal). He has also provided guidance and support to his students over the years to encourage them to follow in his innovative footsteps.

Agaian is internationally known particularly for his pioneering work in image enhancement and image quality measurement. In discussing his approach to his work, Agaian commented, "Say that you recognize a face, but the quality of the image is not good. The computer has to enhance the image, measure the quality, and standardize it. That quality measurement is key." In essence, his codes attempt to educate the computer to pick out the best image and find ways of enhancing the image. He added, "My goal is to enhance, make the invisible visible, and automatically measure the quality of these images. I'm looking to make a system, but these tools may not always work. But then, you are trying to use these tools to solve a problem." Over the course of this process, he discovers what works, what doesn't, and what needs to be tweaked.

Pioneering Work to Improve Many Facets of Our Lives

Agaian has been a member of the CSI faculty since 2017. After he came to Staten

CSI Distinguished Professor of Computer Science **SOS AGAIAN** has given the world myriad solutions to a number of real-world problems over his long career. The primary goal of his research is to enable computers to see, think, learn, and interpret as humans do. His current passion lies in exploring the applications of new bio-inspired imaging and deep learning Artificial Intelligence tools.

Agaian has authored more than 650 papers and ten books, and holds 48 patents/disclosures. He is a Fellow of the SPIE (International Society for Optics and Photonics), IEEE (Institute of Electrical and Electronics Engineers), IS&T (Society for Imaging Science and Technology), and AAAS (American Association for the Advancement of Science).

He has taken his work from theory to commercialization, and the technologies that he invented have been adopted by multiple institutions and used in industry. He is a recipient of the Innovator of the Year Award (2014), and the Tech Flash Titans-Top Researcher-Award (*San Antonio Business*

Island, his research interests have varied from applications in defense, security, and medicine to the fashion industry and art.

His medical applications work with images of cancer, where malignant areas appear more vivid in the enhanced image than in the original. In the cancer scenario, he removes noise from the picture and creates a cleaner, sharper image so that medical professionals can detect cancerous areas that they might have missed in the original image.

In his work with building images, he has improved the quality of these pictures for security applications, particularly nighttime images. His work with thermal imaging provides users with the ability to see where a structure needs insulation. He has also created a military application to thread two separate pictures of a landscape together to provide one, seamless image.

In fashion and interior design, he has created applications that allow designers and customers to reimagine clothing or room interiors by manipulating variables such as color, style of clothing, or furnishings in a room. He also designed a process to select a paint color based on what is already on the wall, in an effort to make a trip to the paint store for the same color paint easier.



Various examples of image Enhancement. *The University of Texas at San Antonio (UTSA)



- Goals: The primary goal of our research is
1. To give the computational devices the ability to "see, learn, and understand of the real world" just as humans do.
 2. To develop new sensing instruments (portable 3D microscopes and multi purpose imaging sensors)
 3. To make more effective the computational device and human collaborations.
 4. To assist in the process of commercializing a discovery.
- Our research is exceptionally interdisciplinary, integrating theories and techniques from mathematics, psychology, physics, statistics, computer vision, machine learning, and computational cameras.



One of Dr. Agaian's applications uses the measure of color to predict the freshness of food.

"My goal is to give the computational devices the ability to see, learn, understand, plan, and act on the real world just as humans do."

DR. SOS AGAIAN

Two of his most interesting applications provide information on the freshness and weight of food. In the former, the application uses the measure of color to predict the quality of freshness of food. In the latter, his 3D application allows one to measure the weight of fruits and vegetables with a 94% accuracy rate using only pictures. "From two-dimensional images, you are generating 3D, and then you are calculating the volume," he noted. With a general average weight plugged into the volume, the weight can be determined.

Agaian has also provided solutions that enhance airport screening images, combining MRI images to improve them. And he recently received recognition for a method to improve underwater images, based on a fishing application that he designed, which assisted in the search for the missing Malaysia Airlines Flight 370.

Preparing the Next Generation of Innovators

Although Agaian takes pride in his many achievements, his main focus is on his students, who range from high school to the Doctoral level.

He assigns his students the task of finding an everyday problem to solve, and they have published journal papers and initiated start-

ups with his encouragement. Their ideas "are all coming from real life," Agaian said.

In explaining the relationship that he has with the people he teaches, Agaian commented that "students can do better work than I can do. I can see problems better than they can. They want to solve problems, and they can work hard and do many things better. Sometimes students are describing something, but they don't see how good the work that they are doing is... [He has the experience and knowledge to guide them.]... They don't have the knowledge, but they have the desire to solve the problem, and they can work hard. And they can generate something you've never thought about. That's the importance of this combination.

"Then, always, I tell them, 'You are stronger than me. Remember, you are young. You can do better than I can.'"

Agaian concluded by mentioning his favorite John Steinbeck quote, "Ideas are like rabbits! You get a couple and learn how to handle them, and pretty soon you have a dozen."

Illustrative examples of color standardization. These biopsy images were taken from several sources using different capturing devices with evident staining variations.

