

Researchers examine Earth's mysteries with Ingenuity funds

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Sometimes 'eureka moments' for innovative science projects can come just as easily over pizza as they do while peering into a microscope. Such is the case with Dr. Dil Joseph, a University of Alberta Department of Electrical and Computer Engineering professor, who has recently been awarded a \$110,000 Alberta Ingenuity grant for his research in imaging sciences. Joseph, the project's principal investigator, is collaborating with Dr. Santo Bains, a long-time friend and colleague. The two met when they were working towards their PhDs at Oxford University.

"We just started chatting and he was doing some work related to climate change and it was very painstaking work where he had to manually pick out these fossils by hand. And I thought, couldn't we automate that?' We just had this talk over pizza a long time ago and now it's happening," said Joseph.

"It's nice to be able to work with your best friend."

Their project will be an interdisciplinary venture that combines Joseph's background in imaging science and Bains's training in palaeoclimatology - the study of climate change over the Earth's geological past via fossil species.

"In terms of studying climate change, people look at the past and try to understand how climate change occurred millions of years ago to develop models that can be used today or in the future, as well as to

understand the past," said Joseph.

According to Joseph, geologists currently employ time-consuming processes where they collect their samples by first drilling for core samples from the ground. Each core sample contains layers of sediment material that correspond to different time periods - the further back in time a sample is, the deeper the layer would be. Geologists like Bains, a visiting professor at the Open University in the UK, and then hand sort out the shells of animals called foraminifera in each layer, which range in different sizes and settled into layers of fossils when they died. These fossils contain clues to the prehistoric environment and geologists are interested in extrapolating the environmental conditions using their shells.

Because a good number of fossils must be picked in order to ensure statistical significance, this process must be repeated numerous times for every sample.

For his study, Joseph hopes to develop a machine that's sensitive enough to automatically detect the distinct visual characteristics of the various forams and sort them in an efficient manner.

"We thought that we can make this process a lot faster if, instead of having a geologist manually pick through these fossils, we'll use a digital camera, which will capture the image and have the machine sort it for us," explained Joseph.

"The first task is to be able to identify the species that we want. So we'll have to develop a more advanced and high-level image processing to recognize specific fossils and distinguish it from other species or dirt."

The Alberta Ingenuity Fund also provided funding for five other U of A researchers during this round of funding announcement. More than

\$750,000 were announced towards U of A researchers and it will allow them to purchase new equipments and develop their proposed projects.

Dr. Yu Jeffery Gu, the recipient of a \$110,000 award from Alberta Ingenuity, plans to solve a different geological riddle.

A professor with the Department of Physics, Gu has been interested in seismic source characterization and numerous aspects of geophysics. For his this research project, he plans to determine the structure, dynamics and history beneath various geological regions worldwide using earthquake recordings.

"My research is really about the study of the genesis of earthquakes and then using the data to infer the structure tens of hundreds of kilometres beneath our feet," said Gu. "Earthquake generates seismic wave and these waves generally travel like X-rays. While X-rays travel through your body and pick up the structure of your bones, seismic waves similarly carry with it the 'memory' of the landscape that it propagated through. My work is to utilize seismic tools to extract the 'memory' from the individual waves."

Though his study interest is on global seismology, Gu explains that his research will also have a local significance and applications.

"To a great extent, we are sitting on top of a very interesting geological region with a wide spectrum of rock ages. I believe my research will nicely compliment previous efforts and, in a way, provide a magnifying glass to take snapshots of the structure at depths greater than 40 to 50 kilometres."

Related links:

The U of A Department of Electrical and Computer Engineering:
www.uofaweb.ualberta.ca/ece/

The U of A Department of Physics: www.phys.ualberta.ca/

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