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Submission Deadline: 15 March 2021
World-renowned academics in Hong Kong addressed key academic questions as they participated in the virtual HKIAS Distinguished Lecture series in November 2020. During two lectures delivered as the second half of a four-part series, senior fellows from the Hong Kong Institute for Advanced Study (HKIAS) explored advanced mathematical analysis as well as pioneering approaches to materials science and engineering.

Going beyond the surface

On November 5, 2020, Philippe G. Ciarlet, HKIAS senior fellow and university distinguished professor at the City University of Hong Kong (CityU), delivered a lecture titled “Nonlinear Korn Inequalities on a Surface.” The accomplished mathematician moved from past to present as he explained how he began working on this subject when he first came to CityU.

In 2002, Ciarlet built upon the Gauss and Codazzi-Mainardi equations and the fundamental theorem of surface theory and became the first scientist to conclude that a surface varies continuously according to its two fundamental forms for different topologies (7). In his talk, he reviewed the results of his work over the past 18 years and highlighted the key question to which he always returns: “As a mathematician, whenever you see a function, you ask, ‘Is this function continuous?’”

Ciarlet also noted that the mathematical concepts relating to fundamental surface theory are not new: “They’ve been around for centuries. What’s new is what will follow.” Introducing his latest research, Ciarlet explained how nonlinear inequalities on a surface could have applications in nonlinear elastic shell theory, in which the fundamental forms of the unknown deformed middle surface of a shell are taken as the new unknowns.

Materials development

On November 25, 2020, Chain-Tsuan Liu, HKIAS senior fellow and university distinguished professor at CityU, spoke about the importance of advancing the field of materials science. He quoted the late Japanese electronics engineer Tadahiro Sekimoto, who stated that “those who dominate materials, dominate technology.” His lecture focused on the technical challenges of developing new structural materials for use at high temperatures, such as in the aerospace industry.

Starting with an overview of the mechanical behavior of different metallic alloys, he noted that most structural alloys lack sufficient strength to be used at elevated temperatures. Design efforts, he said, must focus on enhancing both the strength and ductility of structural materials at different temperatures and working conditions. As an example, he discussed his development of the iridium alloy used as the container material for radioisotope thermoelectric generators on U.S. spacecraft. He went on to highlight the crucial role that steel plays in the global economy and the air pollution problems that are caused by its production, citing as an example the fact that in 2018, the energy used for steel production in China was equivalent to burning 452 million tons of coal. Liu is currently researching ultrahigh-strength steels, which offer an effective way to reduce steel production levels and therefore reduce our fossil-fuel consumption.

Liu concluded his lecture by discussing his research into particle-strengthening, high-entropy alloys for structural applications at all temperatures. “Our development goal is to achieve an effective hardening without any significant loss of ductility in these alloys at ambient and elevated temperatures,” he explained. This new class of metallic materials offers scientists a departure from conventional alloy design and has the potential to be used in high-temperature applications in the future, he told his audience. Supported in part by the Kwang Hua Educational Foundation, the HKIAS Distinguished Lecture series offers scholars the chance to follow the work of internationally renowned academics whose fundamental research will strengthen both our understanding of science and our ability to make scientific advances. HKIAS will continue to organize scientific events, making them available live online to a global audience. In 2021, two new series will be presented: the HKIAS Distinguished Lecture Series on Chemistry and the HKIAS Distinguished Lecture Series on Physics, each to be delivered by three renowned scholars at CityU.

References


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