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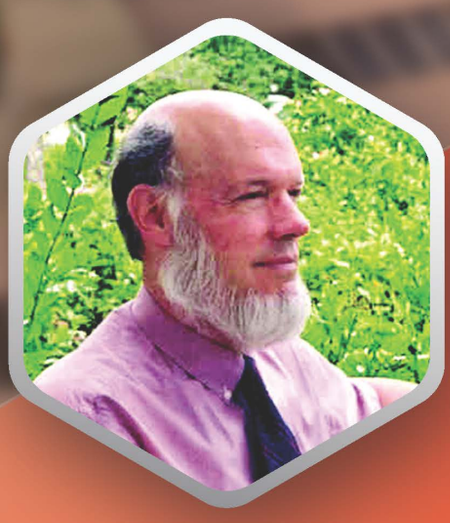
Distinguished Lecture Series

Change Detection, Estimation, and Segmentation

15 December 2021 (Wednesday)
9:00 a.m. - 10:00 a.m. GMT+8 (Hong Kong Time)

Online via Zoom
(Meeting ID: 966 6932 6328)



Professor David Siegmund

Stanford University

David Siegmund is the John D. and Sigrid Banks Professor of Statistics at Stanford University, where he has served twice as chair of the Statistics Department. As a statistician working at the interface between probability and statistics, he focuses on statistical problems that arise in concrete scientific applications and require novel probability theory for their resolution. Until 1985 his research was primarily in sequential analysis, especially problems of the design and analysis of sequential clinical trials. A related interest was sequential change-point detection, motivated by problems of monitoring a continuous production process for changes that can be inferred only from noisy measurements on its output. This led to several years of research on a variety of change-point-like problems, which have found a wide variety of applications. Recently David Siegmund has concentrated on statistical aspects of genetic mapping, i.e., the identification of the location of genes giving rise to phenotypes such as diseases in humans or mammalian model organisms, desirable quantitative traits in agriculturally important plants and domestic livestock. He has also used techniques developed to study change-point problems to give approximate p-values for gapped pairwise local sequence alignments. He received a Guggenheim Fellowship in 1974 and the Humboldt Prize in 1980, and was elected to the American Academy of Arts and Sciences in 1994 and to the National Academy of Sciences in 2002.

ABSTRACT

Beginning with a very brief survey of three remarkable papers in the Amer. J. Math. in 1939 by authors S.O. Rice, H. Hotelling, and H. Weyl and the papers on change-point detection in the 1950s by E.S. Page, I will discuss the maximum score statistic to detect and estimate change-points in the level, slope, or other nonlinearity of an otherwise simple regression function and to segment the sequence when there appear to be multiple changes. Sequential detection of change-points, especially slope changes, will also be discussed. Examples involving temperature variations, levels of atmospheric greenhouse gases, suicide rates, incidence of Covid-19, and excess deaths during the Covid-19 pandemic illustrate the general theory.

Motivated by applications that include fMRI analysis and clustering problems of astrophysics, I will also review methods for detecting "bumps" in random fields.

Combining these methods leads to the study of spatio-temporal processes, where the spatial features can be either (A) unstructured vectors of observations or (B) random fields where changes of interest are expected to be geometrically clustered. Our goals can be either (C) to detect and estimate the position of local changes in the random fields arising from the temporal structure or simply (D) to determine that there are changes in the random fields, without identifying their number or location.

Aspects of this research involve collaboration with Fang Xiao, Li Jian, Liu Yi, Nancy Zhang, Benjamin Yakir, Li (Charlie) Xia, and the late Keith Worsley.

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