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## CARES Visiting Scientists Seminar Series:

### Event-Based Control

Emeritus Professor Karl Johan Åström

Department of Automatic Control, LTH, Lund University, Sweden

**Tuesday 28th March, 5.00pm - 6.00pm**

**CREATE Theatre, Level 2, CREATE Tower**

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**Abstract:** Computer control is normally executed by periodic sampling. For linear time invariant systems this leads to closed loop systems that are linear and periodic. Many properties can be investigated by considering the behavior of the systems at times that are synchronized with the sampling instants using the stroboscopic model. This approach leads to drastic simplifications because the systems can be described by difference equations with constant coefficients. The theory that has emerged is elegant, it has extensive practical applications and it is today the standard technique for implementing computer controlled systems. The intersample behavior can be investigated by the powerful idea of lifting. There are, however, some deficiencies in the theory, particularly for systems with multiple sampling rates, where the complexity of the system depends critically on the ratio of the sampling rates. Event-based sampling is an alternative to periodic sampling. This means that signals are sampled only when measurements pass certain limits. This type of sampling is natural when using many digital sensors such as encoders. Using an analog with integration theory, periodic and event-based sampling can be called Riemann and Lebesgue sampling respectively. Event-based control systems are much harder to analyze and design than systems with periodic sampling because the time-varying nature of the closed loop system can not be avoided. In this lecture we show that event-based sampling is natural in many cases. We will demonstrate that event-based control gives better performance than periodic sampling in some simple examples. Event-based control results in interesting controller architectures that resemble those found in biological systems. Event-based control is a new and rapidly growing research field; international conferences have been held yearly since 2015. This year there were several special session on event-based control at the IEEE Conference on Decision and Control in 2016 and 2017. Publications in the field are growing rapidly.



**Biography:** Karl Johan Åström was educated at the Royal Institute of Technology (KTH) in Stockholm. From 1960 to 1965 he worked for IBM on computer control. In 1965 he was appointed Professor at Lund University, where he founded the new department of Automatic Control. Åström has broad interests covering theory and applications. He has supervised more than 65 PhD students, authored 10 books, published extensively in archival journals and he holds several patents. Åström is a member of the Royal Swedish Academy of Engineering Sciences (IVA), the Royal Swedish Academy of Sciences (KVA) and a foreign member of the US National Academy of Engineering. He has received many honors, among them six honorary doctorates, the 1987 IFAC Quazza Medal, the 1990 IEEE Control Systems Award, the 1993 IEEE Medal of Honor and the 2002 Great Gold Medal of IVA. In 2003 he was inducted in the Process Control Hall of Fame.

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