

## Keynote III

### Why not FIR Filters for Control: FIR Filters for State Space Models

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**Abstract:** An estimation problem deals with recovering some unknown parameters or variables from measured information in physical or mathematical models. For the last forty years, the estimation problem has been widely used in diverse fields, such as speech enhancement, medical imaging, denoising, target tracking, navigation, chemical process, mechanical systems, biological area, etc. Among estimation problems, a state estimator, which is called the filter, has been widely investigated and often combined with control design. Filters can be classified by several aspects such as signal models, filter structures, optimal criteria, and internal properties such as dependence of initial state information and unbiased or deadbeat property.

In this talk, filters with the finite impulse response (FIR) structure and the unbiased or deadbeat property are proposed for the existing or new optimal criteria, together with above properties. We propose various versions of FIR filters such as

Minimum variance FIR filter for stochastic systems: 1) Kalman FIR filter with unknown initial information, 2) Optimal FIR filter with initial state estimation, 3) Unbiased optimal FIR filter  
Minimax FIR filters for deterministic systems: 1)  $L_2$ - $E_2$  FIR filter, 2) Guaranteed  $H_\infty$  FIR filter, 3)  $H_\infty$  FIR filter.

FIR filters proposed will be very useful for many signal-processing problems where signals are represented by state space models.

The concept of FIR filters is applied to parameter estimations and controls. The following topics will be presented:

Application to identification: Unbiased and quasi-deadbeat parameter estimation

Application to control: Receding horizon finite memory control for output feedback controls.

Similar to FIR filters, a receding horizon control (RHC) has received much attention because it has many advantages including simple computation, tracking performance, I/O constraint handling, and extension to nonlinear systems, when compared with steady-state linear quadratic control. It has been used widely in the process industries. The RHC and the FIR filter have key ideas in common. They are based on the idea that the objective value, i.e., a control or an estimate, should be obtained from information on the recent time interval to adapt to the latest circumstances very fast. Since RHC is for state space models and FIR filter is preferable in signal processing fields, it is natural that FIR filters for state space models are worth trying. To control engineers, an

infinite impulse response (IIR) filters have been utilized in most case but FIR filters have little attention. This motivates this work.

**Biography:** Wook Hyun Kwon received B.S. and M.S. degrees in electrical engineering from Seoul National University in 1966 and 1972, respectively, and a Ph D. degree in control engineering from Brown University in 1975. He was a research associate at Brown University (1975-1976), an adjunct assistant professor at the University of Iowa (1976-1977), and a visiting assistant professor at Stanford University (1981-1982). He has been with Seoul National University since 1977, where he is currently a professor of School of Electrical Engineering.

Dr. Kwon has published more than **65** International Journal papers and approximately **120** International Conference papers, mostly in the areas of predictive controls, time-delayed system, FTR Filtering, real-time computer applications for automation.

Dr. Kwon has devoted himself to promoting control engineering in Korea, He was a key founder of the Korea Automatic Control conference, in which about 650 persons participate every year. He was a key founder and then President of the Institute of Control, Automation and Systems Engineers (ICASE) in 1999. He was also President of the Korean Institute of Electrical Engineers (KIEE) in 2001.

He was a member of the founding Steering Committee of ASCC. He was Chairman of the Asian Control Professors Association (ACPA) for 1999-2000. He is serving IFAC as Vice-President from 1999. He received the National Academy of Sciences Award, the highest formal academic award in Korea. He is a Fellow of the Korean Academy of Science and Technology (KAST), a member of the National Academy of Engineering of Korea (NAEK), and a Fellow of Third World Academy of Science (TWAS).