Rapid Design of Digital Filters and DSP Systems

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Abstract:
Increasingly, conventional “textbook” targets for digital filters are being supplanted by the need for oddball arbitrary gain and phase wiggles - where textbook design practice provides little guidance. Minimum-phase, fractional-delay, complex-coefficient filters, inverse filters, point time and frequency-domain constraints, IIRs with linear phase over passbands - all in various mixes - are emerging elements in customers’ wish-lists for more sophisticated classes of filters and the tools that can reliably design them!

Bearing in mind well-recognized progress in interactive graphical manipulations, it seems strange that the human has up to now been consigned such a back-seat, passive role in filter design. Basically the scene has been - and continues to be - that much intellectual power is expended in devising clever algorithms which unearth obscure but potent optimization procedures and then a hands-free algorithm is set to churn along automatically. People have mostly just harvested the results (the coefficients), take-it-or- leave-it. The tools and interaction techniques described here put the person firmly back in the design-shaping loop, but eliminate the drudgery of building the test harness and the ways of relating decisively with the design flow.

DSP systems most often embrace one or more filters, but the overall task (say in communications or instrumentation applications) sweeps much wider than just filtering. **Proof-of-Concept experimentation** of systems under development needs to be done early, while re-thinking is cheap and detailed implementation choices are not yet entrenched. A special Simulink-based LabKit is described for executable graphical block diagram level assembly and assessment of new DSP algorithms. Within a few short minutes the essence of a processing subsystem can be wired-up (virtually), flexibly exercised, and visually monitored on powerful Signal Analyzers so that algorithmic effectiveness can be swiftly determined and alternatives explored with ease.

Biography: *Gerald D. Cain* was born in Anniston, AL and is a Senior Member of the IEEE and a Fellow of the IET. He received the B.S.E.E. degree from Auburn University, Auburn, AL, in 1963, and the M.S.E.E. degree from the University of New Mexico, Albuquerque, in 1965. In 1970 he was awarded a Ph.D. degree in communication theory from the University of Florida at Gainesville. He participated in the Technical Development Program of Sandia National Laboratories, refining early laser radars and developing test range timing and control instrumentation. He joined Teledyne Brown Engineering Company at Huntsville, AL in 1965 and led a small team of radar analysts engaged in system modeling, simulation and electronic countermeasures studies.

In 1971 Cain took up a lecturing post at the University of Westminster in London, developing courses in signal processing. He became Head of the University’s School of Electronic and Manufacturing Systems, Professor of Digital Signal Processing and Director of its Centre for Microelectronic Systems Applications. From 1999 to 2001 he was with The MathWorks Limited at Cambridge, England, as Business Manager, DSP and Communications. In this capacity he oversaw delivery of consultancy projects employing the MATLAB family of DSP software, identification of new software product opportunities in communications and instrumentation areas, customer training, and specialist product development. Since 2001 Cain has been a Director of two companies: Signalytics (a training and consultancy company) and DSP Creations Limited (a DSP software firm).