A Fully Digital Antenna Control System

Dr. Charles El Busch
Scientific-Atlanta, Inc.
3845 Pleasantdale Road
Atlanta, Ga 30340

ABSTRACT

Antenna control systems are typically a combination of digital time domain algorithms for relatively simple mathematical operations followed by analog frequency domain filtering for mechanical resonance compensation. This paper presents an innovative, fully digital control system that utilizes the advantages of both modern sampled time domain control methods and classical frequency domain conceptualization.

The unit is designed to perform all functions of the antenna control problem in the digital domain including generation of command coordiantes, position, rate, torque loop closure, servo compensation, and torque bias processing. Problems related to analog processing such as offsets, drift, and dynamic range are completely avoided in the digital domain. Non-linear and adaptive filtering is used to correct system non-linearities due to saturation, backlash, friction, and dead band. Rate and acceleration limiting is provided in the digital processing along with an optimal state estimator that is used to dramatically decrease system servo errors for dynamic targets. Digital filtering is accomplished by utilizing an internal bi-linear transform between the frequency domain input parameters familiar to most control engineers and the cascaded z-transform filter coefficients used by the control algorithms. All control and servo control parameters are programmed into the units' nonvolatile memory by the control engineer using an interactive terminal attached to a service port. Changes to the servo compensation that often required hours of analysis and electronic component changes can now be effected and evaluated in seconds.

Final outputs from the unit are motor drive commands that are converted to analog form for power amplifier use. All control and status communication between the unit and a host computer or operator console is via a high speed, fiber optic, serial data link.