Implementing Software Radar Systems at Millstone Hill

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We have recently implemented a Software Radar System as the production data taking and control system for the Millstone Hill Incoherent Scatter Radar. In a Software Radar the traditional real-time hardware, control, and signal processing elements of a radar system are replaced by software running on general purpose computer systems and interconnected by a high speed and low latency data network.

From our efforts to develop this system we have identitified a number of key architectural elements which are important for achieving performance, modularity, and scalability in distributed systems of experimental radar instrumentation. These elements include global coherence, reference signal digitization, multicast interconnection, persistence management, and a large number of generic software patterns (channels, signal chains, distributors, listeners, recorders, replayers, filterers, triggers, bridges, proxies, schedulers, and weavers). We will discuss the role of these elements in the design of the Millstone Hill Software Radar. In particular we will focus on the structure and performance of our implementation and we will show example incoherent scatter radar data and control information from different stages in the data processing chain.

We will also discuss the design constraints on Software Radar scalability and performance in the context of implementing practical monostatic radars and more novel multistatic Coherent Radar Networks. As part of this discussion we will briefly describe the design of a Coherent Radar Network to provide complementary measurements for the Millstone Hill Incoherent Scatter radar. The ISIS Array (Intercepted Signals for Ionospheric Science) is enabled by Software Radar technology and will combine active radar, passive radar, beacon scintillation, and beacon tomography into a single distributed instrument design capable of observing wide regions of the ionosphere.