Manifold-based Interference Mitigatation

Joshua W.K. Chong and Albin J. Gasiewski
University of Colorado Boulder, Department of Electrical Engineering

There is increasing competition for use of the radio spectrum among the fundamental types of spectrum users: 'active' users who transmit radio signals, e.g. voice or data communications, radar surveillance, and Earth remote sensing radars; and 'passive' users who operate in receive-only mode, e.g. in radio astronomy and passive remote sensing. Both active and passive users need increasing amounts of spectrum usage; the former is driven by the telecommunications industry which continually invents new uses for active systems, while the latter needs increased spectrum to obtain the increased sensitivity required for new studies and services. As such, there is significant potential for passive services to suffer radio frequency interference from active services, even in bands where the passive services are the primary users.

Mitigitation of this interference can be accomplished by first modeling interfering sources and passive observational instruments in a 7-dimensional hyperspace called the 'electrospace', which is defined by time of use, spatial coverage, frequency of operation, transmission power(of the interferer), and required sensitivity(of the radiometer). The spectral, spatial, angular and temporal needs of each eligible service within a band can be defined by a manifold. Intersections of these manifolds in electrospace define 'competitive hypervolumes' where interference occurs; once these intersections are identified, priority-based arbitration will be performed to determine eventual spectrum usage rights. A user with lower priority would have to change some aspect of its electrospace manifold such that an intersection no longer occurs. This change would not be permanent but only for the period of time where the higher-priority user is using the competitive hypervolume, for example; it is the eventual aim of this project to develop an automated technique for arbitration and temporary service modification of the lower-priority user. Instead of being constrained to a specific passive observational technique, this method of interference mitigation is general and can be applied to any type of spectrum user. This paper discusses the problem of finding a common descriptor language, i.e. a relevant set of parameters to adequately represent a wide range of spectrum users, e.g. Keplerian orbital elements describe the position and velocity of a an Earth-observing satellite. Preliminary results in the modeling of spectrum users in electrospace and determination of competitive hypervolumes will also be presented.