PROPOSAL:

A New Approach to Real-Time Interference Cancelation System in Radio Astronomy

Radio frequency interference (RFI) is a growing problem not only for research in radio astronomy, but also is a serious challenging problem in other services. The ITU (International Telecommunication Union) has defined and regulated the usage of the radio spectrum by allocating various frequency bands for different services including radio astronomy, point to point communication, military, satellite communication, etc. Regulation can protect a few windows in the radio spectrum for radio astronomer, but many experiments in radio astronomy now need to access parts of the spectrum outside the reserved regions. Spectral lines, for example, may be significantly Doppler-shifted, and therefore require an observation window far from their rest frequencies. Moreover radio flux densities from cosmic sources are typically well below those due to other services, often the out-of-band emission from other services limits the sensitivity of astronomical observations. However, extracting weak astronomical signals in the spectral region affected by RFI remains a technological challenge.

Several RFI mitigation techniques have been developed and applied for radio astronomy application in recent years [1], [2]. Conventional techniques such as RF Filters, RF shielding, post-processing of data [3] and the latest technique is the real-time adaptive filtering algorithms [4] have been only somewhat successful, but none has been sufficient for radio astronomy observations. Additionally some of those techniques are costly and complicated and in most cases are not practical. Thus research into developing new mitigation techniques is necessary.

In present work we will describe, for a first time, the novel, practical and cost effective design of interference cancellation system in the context of radio astronomy instrumentation. Also we will carry out an experimental setup and present some results for our prototype receiver. We propose to develop high performance systems based on waveguide and microstrip devices for application in centimetre and millimetre astronomy with particular focus on single dish telescope. Required devices like phase-shifters, hybrids, couplers, waveguides, filters, etc. can be developed using either waveguide or planar technologies. The electromagnetic requirements of the devices will depend on the specific astronomical application under study.

The modelling and the design of the devices will be done mainly using electromagnetic finite element analysis software such as Ansoft HFSS or FEKO. The required devices will be manufactured and then separately tested using RF laboratories equipment's. Developing final integrated system and optimisation for testing with specific astronomical application will be carrying out as a result of this research.

References:

[1]P. A. Fridman, W. A. Baan, **"*RFI mitigation methods in radio astronomy*",** Astronomy and Astrophysics, v.378, p.327- 344, 2001.

[2] W. A. Baan, P. A. Fridman, R. P. Millenaar, **"*Radio Frequency Interference Mitigation at the Westerbork Synthesis Radio Telescope: Algorithms, Test Observations, and System Implementation",*** the Astronomical Journal, Volume 128, pp. 933-949, 2004.

[3] R.N. Ghose, **"*Interference Mitigation: Theory and Application"*,** IEEE Press, New York, 1996.

[4]C. Barnbaum, F. R. Bradley, ***"A New Approach to Interference Excision in Radio Astronomy: Real-Time Adaptive Cancellation",*** the Astronomical Journal, Volume 116, pp. 2598-2614, 1998.