Radio Frequency Interference Mitigation Techniques for Pulsar Observations

Scott M. Ransom
McGill University Physics Dept., Montreal, Quebec, Canada

Abstract

Radio Frequency Interference (RFI) has become a tremendous problem for radio pulsar astronomers over the past decade. Since pulsars are intrinsically weak radio sources that show significant flux variations over timescales of several microseconds, their observation requires large telescopes with sensitive receivers, long integration times, wide bandwidths, and fast sample rates. Additionally, the dispersive effect of the ionized interstellar medium necessitates maintaining high frequency resolution across the bandwidth as well. Unfortunately, these characteristics of pulsar observations make them extraordinarily sensitive to interference as well as to pulsars.

Sensitive searches for new pulsars are especially vulnerable to interference. In general, a pulsar searcher must contend with three basic forms of RFI during a search observation: 1. narrow bandwidth but long duration signals (*i.e.* television and radio stations), 2. strong broadband but short duration events (*i.e.* lightning, garage door openers, microwave ovens), and 3. low-level broadband emissions (*i.e.* unshielded electronics). Each of these interference forms must be dealt with – and hopefully removed – in a different manner.

Over the past several years, I have developed a suite of pulsar analysis software designed specifically for high sensitivity searches of long duration radio observations. RFI mitigation was designed into the system at a fundamental level and has proved essential in today's noisy interference environment. The software removes each of the three main types of interference mentioned above using a series relatively simple time- and frequency-domain algorithms. In this talk I will describe the RFI mitigation algorithms used in this software, their effectiveness at removing interference in data of widely varying quality, and the potential interference issues pulsar astronomers will face in the coming years.

RFI