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pycraf: Spectrum compatibility studies for the Radioastronomy Service

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1 Extended Abstract

Radio-astronomical measurements often suffer from man-made interference, which can make the processing of the recorded data much more challenging or even render the data completely useless. One can make a distinction between wanted and unwanted radiation, the former being generated by active radio services such as mobile communications applications, civil or military RADARs, and radio/TV broadcasts. All electric and electronic devices also produce unwanted emission, at very different levels. Radio services are subject to regulation by national administrations and international bodies such as the ITU-R, which are responsible for allocation of frequency blocks of the radio spectrum to the interested parties.

Optimal use of the very limited electromagnetic spectrum can only be achieved, if the various services do not affect each other. Therefore, it has to be made sure that (harmful) interference is avoided even before a new service is launched. This is usually accomplished by means of compatibility calculations. In simpler cases, it is sufficient to calculate the emitted power of a potentially interfering transmitter, determining the coupling loss and comparing the received power with some threshold. However, for complex systems such as mobile communications networks, deployment of the devices, dynamical antenna patterns, and aggregation of the power levels have to be considered, making these compatibility studies numerically challenging.

The radio-astronomical service (RAS) is expected to perform compatibility calculations if it may be affected by a new application or service. For this, we developed a Python library, the *pycraf* package, which aims to provide the necessary functionality to ease the calculations. Most importantly, it ships with an implementation of the ITU-R Recommendation P.452 that contains an algorithm to determine the path propagation loss between two stations accounting for the terrain height profile.

In our contribution, we will present the *pycraf* package, its features, and possible use cases. Furthermore, the upcoming LTE-5G networks, which are going to operate at K-band or above, are analyzed and their potential impact on RAS observations are discussed.