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About the extension of the coordinate parametrization of radio sources in VLBI

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Usually celestial radio sources in the celestial reference frame (CRF) catalog are divided in three categories: defining, special handling, and others. The defining sources are those used for the datum realization of the celestial reference frame, i.e. they are included in the No-Net-Rotation (NNR) constraints to maintain the axis orientation of the CRF, and are modeled with one set of totally constant coordinates. At the current level of precision, the choice of the defining sources has a significant effect on the coordinates. For the ICRF2 295 sources were chosen as defining sources, based on their geometrical distribution, statistical properties, and stability. The number of defining sources is a compromise between the reliability of the datum, which increases with the number of sources, and the noise which is introduced by each source. Thus, the optimal number of defining sources is a trade-off between reliability, geometry, and precision.

In the ICRF2 only 39 of sources were sorted into the special handling group as they show large fluctuations in their position, therefore they are excluded from the NNR conditions and their positions are normally estimated for each VLBI session instead of as global parameters. All the remaining sources are classified as others. However, a large fraction of these unstable sources show other favorable characteristics, e.g. large flux density (brightness) and a long history of observations. Thus, it would prove advantageous including these sources into the NNR condition. However, the instability of these objects inhibit this. If the coordinate model of these sources would be extended, it would be possible to use these sources for the NNR condition as well. All other sources are placed in the "others" group. This is the largest group of sources, containing those which have not shown any very problematic behavior, but still do not fulfill the requirements for defining sources.

Studies show that the behavior of the sources can vary dramatically in time. Hence, each source should be modeled individually. Considering this, the shear amount of sources, in our study more than 900 are included, sets practical limitations.

We decided to use the multivariate adaptive regression splines (MARS) procedure to parametrize the source coordinates, as they allow a great deal of automation as it combines recursive partitioning and spline fitting in an optimal way. The algorithm finds the ideal knot positions for the splines and thus the best number of polynomial pieces to fit the data. We investigate linear and cubic splines determined by MARS to "human" determined linear splines and their impact on the CRF.

Within this work we try to answer the following questions: Do we still need the categorizations in stable, special handling and other sources? If yes, how can we find optimal criteria for the definition of these categories? Whats the best approach to find the best fitting polynomials? And finally, what can we gain by introducing this type of parametrization within the CRF determination?

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