Dynamical model for the evolution of Dst

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A mathematical model for the dynamics of the Dst index has been identified using the NARMAX OLS-ERR methodology. The NARMAX OLS-ERR algorithm, which is widely used in the field of system identification, is able to identify a mathematical model of a wide class of nonlinear systems using input and output data sets. The Dst index is used as the output and a solar wind-magnetosphere coupling function is used as one of the inputs, along with a pressure term and an IMF term. The correlation function is often used to justify coupling functions, however, the correlation function does not work for nonlinear systems. Recently, as an alternative, the error reduction ratio (ERR) which is part of the NARMAX model structure selection, has been used to assess prediction capability of various coupling functions. In this study, it was shown that $p^{1/2}V^{4/3}B_T \sin^6(\theta/2)$ was statistically the most appropriate coupling function. The study deduced analytically that the factor $\sin^6(\theta/2)$ must appear in previous theoretical models (Kan and Lee). It is this newly deduce coupling function that has been used as an input to model the Dst dynamics. It was shown that forecasting ability of the identified model are superior to previous models.