E014-P005 Time: May 29 17:00-18:30

Nonlinear time series analysis of magnetic field data observed in the solar wind-magnetosphere environment

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Dynamics of the solar wind-magnetosphere coupling has been examined based on the input-output system approach, either with the linear prediction filtering or the nonlinear prediction filtering [Bargatze et al. , 1985 ; Klimas et al. , 1992 ; Vassiliadis et al. , 1995]. However, it is difficult to decide objectively which of these techniques is superior for application to the solar wind-magnetosphere environment (SWME): some people argue that the linear method (e.g. Fourier analysis) is enough to explain the dynamics of the SWME, while others insist that the nonlinearity included within the system plays crucial roles.

In this presentation we examine the degree of nonlinearity using the magnetic field data observed by Geotail satellite, by performing surrogate data analysis, and by evaluating the fractal dimension and Lyapunov exponent computed from the data sets. Then we discuss, to which degree the system is deterministic, i.e., the relative importance of the deterministic evolution compared with evolution due to external 'noise' given to the system.