

The Reconstruction of Three-Dimensional MHD Equilibria Based on Hi-resolution Observation of Photospheric Magnetic Field

Satoshi Inoue[1]; Kanya Kusano[2]; Satoshi Masuda[3]

[1] STEL, Nagoya Univ.; [2] ESC/JAMSTEC; [3] STEL, Nagoya Univ

It is important to reveal the three-dimensional (3D) structure of coronal magnetic field to understand storage and release process of energy causing solar flares and Coronal Mass Ejections (CMEs). It has been widely believed that the coronal magnetic field is well approximated by force-free field, because plasma beta value is very low in the solar corona. However, since the force-free equation is nonlinear, it is impractical to solve that analytically. Therefore, it is necessary to derive the coronal magnetic field numerically from magnetogram observation for the photospheric surface. Solar Optical Telescope (SOT) aboard *Hinode* satellite, which was launched in the last year, may provide the high resolution magnetogram, which will be ideal data to reconstruct the 3D coronal magnetic field in the solar corona.

However, although the several methods have been proposed to reconstruct the coronal magnetic field, the computational cost for the reconstruction of 3D field is too expensive to apply them directly to the SOT data larger than about 1K pixels. In this study, therefore, we have developed a new extrapolation method by adapting a multi-grid technique, aiming to perform the direct analysis using high-resolution magnetogram from *Hinode*/SOT. We can expect that the multi-grid technique may accelerate the convergence to force-free field because the information of larger scale on the boundary condition can faster propagate into the inside of domain than the smaller component. First, we compared the convergence speed between the multi-grid procedure and the non-multi-grid procedure, using semi-analytical nonlinear solution introduced by Low & Lou (1990). As a result, we have demonstrated that the multi-grid procedure is very effective not only for the converging speed, but also for the accuracy of the final solution of nonlinear-force-free field, as long as the boundary condition is well consistent with the force-free condition. In addition, we will argue the applicability of the force-free field solver onto the problem including the finite beta effect, and the feasibility of practical data analysis using SOT data.