Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM35-P01 Room:503 Time:May 2 16:15-17:30

Development of magnetic field tracking module for analyzing a decaying sunspot

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In order to analyze the structures of magnetic fields using the data from Solar Optical Telescope (SOT) on board the Hinode satellite, we have developed the automatic tracking module, which detects the magnetic region and tracks the time variation of each region.

The module, based on three thresholds, intensity, size, and distance, has main three functions: (1) detect the magnetic fields based on the intensity threshold, (2) remove the micro region by the size threshold, (3) based on move distance by time variation, detect the same regions and track them.

We made simple sample data for test and checked on the accuracy of our tracking module.

We applied the module to sunspot and analyzed the time variation of decaying sunspot which is one of the sources of magnetic element in the solar surface.

We have use the magnetograph data which was observed by Hinode/SOT from 29 Dec 2009 to 2 Jan 2010. We also discuss the north-south/east-west asymmetry of the decaying process in the active region.

Keywords: sunspot, development of module, auto detection, auto tracking

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Application of feature recognition technique in the investigation of magneto-convection on the solar surface

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We show the recent feature recognition technique and its benefits in the investigation of magneto-convection on the solar surface using observational and numerical approaches.

The magneto-convection on the solar surface is important not only as a trigger of many surface energetic events, e.g. solar flare, jet, and X-ray bright point, but also as an actual example of the most detailedly observed and numerically simulated magneto-convection on the stellar surface owing to its closeness to the earth. However, the elements of magneto-convection (<1,000km), the basic convective cells and magnetic patches formed by convective motion, are much smaller than solar global scale(~70,0000km). It means that we need large field of view to catch up enough number of structures simultaneously with high spatial resolution to capture such small scale structures. Thanks to the improvement of engineering technique for satellite observation and computers for numerical calculation, we are now able to catch such a large scale structure at the same time. However, the new difficulty, how to investigate statistical characters of convective cells and magnetic structures in such huge data sets, has just shown up in the analysis.

Because of this situation, feature recognition and tracking technique is now focussed on. In this presentation, we want to introduce the auto-recognition and tracking code of magnetic patches and convective cells on the solar surface. Further it is shown that the statistical characters obtained through the analysis of observational data and numerical calculation data based on the auto-recognition and tracking code. We want to note that the feature tracking technique drastically improve statistics of the analysis drastically. We also want to discuss about the applicants of feature tracking technique with the scientists in the other fields though this collaborative session.

Keywords: the Sun, magneto-convection, feature recognition

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On stability properties of the numerical Cherenkov instability in relativistic plasma flows

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We examined stability properties of the numerical Cherenkov instability in relativistic plasma flows. Particle-in-cell simulation code package, pCANS, was used for the numerical analysis. With the implicit FDTD method for Maxwell equations, we found that the instability was greatly inhibited with the CFL number of 1.0. Numerical tests with various CFL numbers ranging from 0.5 to 1.0 showed that the growth rate remarkably decreased at CFL = 1.0 following a gradual decrease from the value at CFL=0.5. The implicitness factor (alpha=0.5 for Clank-Nicolson method) was also found to control the width of the dip. The present result contrasts with the recently reported results (Vay et al., 2011, Godfrey & Vay, 2013) in which the magical CFL number were 0.5 and 0.7 respectively for their different explicit field solvers. We present the result with the detailed dispersion relation of the implicit field solver and its application to relativistic collisionless shock simulations.

Keywords: particle-in-cell simulation, relativistic plasma, numerical Cherenkov radiation, shocks

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Electron hybrid code simulations with OhHelp load balancer

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A spatially one-dimensional electron hybrid code has been developed for the study of the generation process of whistler-mode chorus emissions and relativistic electron acceleration in the Earth's inner magnetosphere [1-3]. In the electron hybrid code, we treat cold electrons as a fluid and energetic electrons as particles by the Particle-in-Cell (PIC) method. Since we assume an inhomogeneous background magnetic field in the simulation system so as to treat the bounce motion of energetic electrons along a magnetic field line, the distribution of energetic electrons in the system is non-uniform and energetic electrons move around the magnetic equator assumed at the center of the simulation system. While the electron hybrid code has been parallelized through the particle decomposition method, we need to improve the scalability of the electron hybrid code so as to use a large simulation system and billions of particles for simulations under initial conditions corresponding to the real magnetosphere.

In the present study, we have developed a spatially one-dimensional electron hybrid code domain-decomposed by OhHelp [4]. The OhHelp is a library which enables us to conduct PIC simulations by achieving both dynamic load balancing and scalability. The efficiency and scalability of OhHelp have been confirmed by a 3D full PIC simulations [5]. We show the efficiency and scalability of the developed code tested on the system A (Cray XE6) of Academic Center for Computing and Media Studies, Kyoto University. We compare the performance of the developed code and those of the code with the particle decomposition.

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Keywords: dynamic load balancer, PIC simulation