X04b Data Compression for Multi-Dimensional Numerical Simulations

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Numerical simulation becomes powerful tool recently in astrophysical field according to development of processing speed of operation of the super computer because people can perform multi-dimensional numerical simulation. However they face the huge amount of data at the same time. Data compression is very useful to solve this problem. It can reduce the volume of data, i.e., it can save the space of disk, or a user can write the dynamical data to files frequently and also can save cpu time for out put. Here we propose a new compression algorithm which may be mainly used for visualization or rough analyses of multi-dimensional numerical simulation results because our data compression algorithm is not lossless.

The detail description of compression algorithm is shown in our poster. We obtain the compression efficiency (CE) defined by $\mathrm{CE} = (1 - m/r) \times 100\,\%$ with the file size of original data r and that of compressed data m for three typical problems of numerical simulation in astrophysics. Our compression algorithm always gives $\mathrm{CE} > 75\,\%$ and we find that CE depends on complexity of spatial structure of the system and the choice of data range to be kept with high resolution. For example, as a result, when we adopt the way that the values of data in "void" as seen in cosmological simulations should be rounded off more than those in "filament" or "sheet", $\mathrm{CE} = 98\%$ is achieved. The CPU-time spent during the compression stage is found to be negligible compared with that of the dynamical stage in the simulation.

We compare the compressed data with the original data by showing snapshots of the models in the table and graphs of the time evolution of numerical simulation of the galaxy formation and discuss the problem of this method. Finally we propose that the source program of our data compression written in FORTRAN language can be used widely.