Algebraic analysis approach for multibody problems II

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Some of the authors have developed an algebraic model for multibody problems, and have shown that the momentum transfer cross-section with our model is in good agreement with the exact one [1]. However, all the field particles are at rest throughout the calculation in Ref. [1].

In this study we have loosen the restriction on the field particles and have applied the algebraic model. The change in position $\Delta \boldsymbol{r}$ (results not shown) is in good agreement with the exact one. However, the absolute value of the changes in velocity $\Delta \boldsymbol{v}$ are close to exact one, which means the orientation of $\Delta \boldsymbol{v}$ are not always correct.

Figure 1 shows the variance of the velocity change, $\langle \Delta \boldsymbol{v}^2 \rangle$, of a test particle initially at rest. Field particles are randomly distributed in the phase space $(\boldsymbol{r}, \boldsymbol{v})$. The variance $\langle \Delta \boldsymbol{v}^2 \rangle$ is proportional to the collision cross-section and converged around 200,000 Monte Carlo trials as shown in Fig. 1 in which the full multibody calculation using the Runge-Kutta-Fehlberg scheme is also shown as 'exact'. The variance, i.e the colision cross-section, is in good agreement with the exact one.

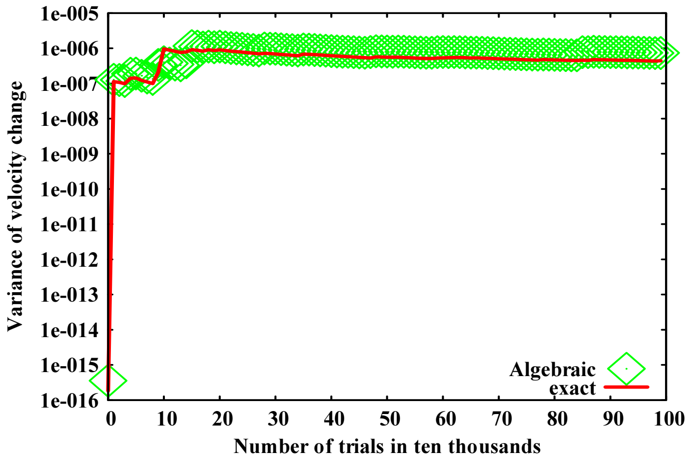

Figure 1: comparison of the variance of the change in velocity

The jump in the variance at around ten thousands-th trial indicates that the large-angle scattering occurs. Although we cannot apply this method to analysis of the motion of individual particles, the present method has high prediction accuracy for the statistical nature of a high number of particles, such as the variance of the change in velocity.

[1] S. Oikawa, H. Funasaka, J. Plasma Fusion Res. **36** (2008) S1073