A FORMULATION OF CONSERVING IMPACT SYSTEM BASED ON LOCALIZED LAGRANGE MULTIPLIERS

Y. Miyazaki[a] and **K.C. Park**[b]

[a]Department of Aerospace Engineering, College of Science and Technology
Nihon Univeristy
7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan
miyazaki@forth.aero.cst.nihon-u.ac.jp

[b]Center for Aerospace Structures and Department of Aerospace Engineering Sciences
University of Colorado at Boulder
Campus Box 429, Boulder, CO 80309-0429
kcpark@titan.colorado.edu

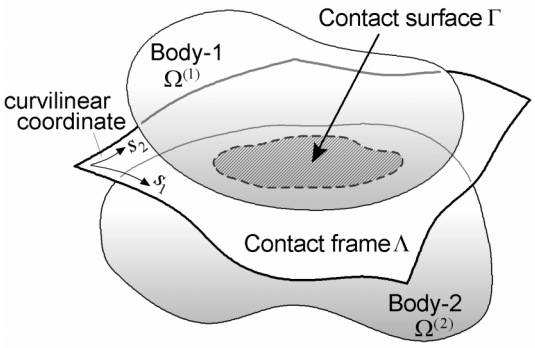

Figure 1. Contact frame

The numerical simulation of the contact/impact between deformable bodies has been receiving a great deal of attention in engineering field. The appropriate approximation of the contact pressure and the solution method of the non-penetration condition are the most important subjects for the accuracy of the contact analysis. In case of frictional contact/impact, it is also important to ensure the existence of the solution that satisfies the constitutive relation of the frictional force including the inequality. Rebel, Park and Felippa [1] has proposed a formulation of frictional contact problem that overcomes these numerical difficulties. Their formulation introduces a contact frame as in Figure 1. The contact frame possesses its independent displacement degrees of freedom and its associated equilibrium equations. The equilibrium equations consist of the localized Lagrange multipliers [2]. The non-penetration condition is established between the contacting nodes and the frame. The friction is taken into account between the body and the frame, and the inequality associated with the frictional force is exactly satisfied. The finite element mesh associated with the contact frame is determined uniquely by the contact patch test so that the obtained pressure distribution has high accuracy.

The contact/impact system is essentially a conserving system, so that the energy and momentum should be exactly conserved. However, it is not easy to ensure the conservation condition and the numerical stability in the transient analysis because of high nonlinearity of the system. The present work aims to extend the contact frame formulation of Rebel, Park and Felippa [1] to the dynamic case by applying the energy momentum conservation algorithm [3]. The present method has more numerical efficiency than the conventional one, and it is available to the frictional problem, and the conservation condition is satisfied exactly in the frictionless impact system and approximately in the frictional one.

References

[1] G. Rebel, K.C. Park, and C.A. Felippa, "A contact formulation based on localised Lagrange multipliers: formulation and application to two-dimensional problems," *International Journal for Numerical Methods in Engineering*, v. 54, p. 263-297, 2002.
[2] K.C. Park, C.A. Felippa, and U.A. Gumaste, "A localized version of the method of Lagrange multipliers and its applications," *Computational Mechanics*, v. 24, p. 476-490, 2000.
[3] T.A. Laursen, and G.R. Love, "Improved implicit integrators for transient impact problems – geometric admissibility within the conserving framework," *International Journal for Numerical Methods in Engineering*, v. 53, p. 245-274, 2001.