Abrasive Waterjet Machining Simulation by Coupling Smoothed Particle Hydrodynamics/Finite Element Method

WANG Jianming [1, 2, *], GAO Na[1], and GONG Wenjun[1]

1 School of Mechanical Engineering, Shandong University, Jinan 250061, China

2 Key Laboratory of High Efficiency and Clean Mechanical Manufacture of Ministry of Education, Shandong University, Jinan 250061, China

Received May 19, 2009; revised August , 2010; accepted August , 2010; published electronically August , 2010

Abstract: In dealing with abrasive waterjet machining(AWJM) simulation, most literatures apply finite element method(FEM) to build pure waterjet models or single abrasive particle erosion models. To overcome the mesh distortion caused by large deformation using FEM and to consider the effects of both water and abrasive, the smoothed particle hydrodynamics(SPH) coupled FEM modeling for AWJM simulation is presented, in which the abrasive waterjet is modeled by SPH particles and the target material is modeled by FEM. The two parts interact through contact algorithm. Utilizing this model, abrasive waterjet with high velocity penetrating the target materials is simulated and the mechanism of erosion is depicted. The relationships between the depth of penetration and jet parameters, including water pressure and traverse speed, etc, are analyzed based on the simulation. The simulation results agree well with the existed experimental data. The mixing multi-materials SPH particles, which contain abrasive and water, are adopted by means of the randomized algorithm and material model for the abrasive is presented. The study will not only provide a new powerful tool for the simulation of abrasive waterjet machining, but also be beneficial to understand its cutting mechanism and optimize the operating parameters.

Key words: abrasive waterjet machining, randomized algorithm, coupling SPH/FEM, abrasive material models

*Corresponding author. E-mail: wangjianming@sdu.edu.cn

This project is supported by Shandong Provincial Natural Science Foundation of China (Grant No.Y2007A07)

E-mail: cjme@mail.machineinfo.gov.cn **http:** // www.cjmenet.com.cn