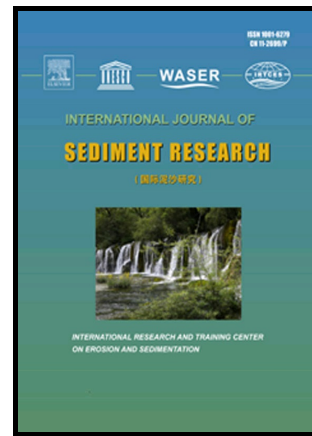


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Experimental study of bed-load transport using particle motion tracking

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ABSTRACT

A series of experiments were conducted in a flume to study bed-load transport. The motion of bed-load particles was captured by a series of images taken by a high-speed camera. A novel particle motion tracking method was developed to automatically detect all the moving particles and calculate the instantaneous particle velocities. The instantaneous bed load transport rate was calculated based on particle velocity and the volume of moving particles. To verify this method, bed load transport rate based on the image processing technique was compared to the manually measured ones as well as data from other experiments. Results showed that the new technique made it possible to quantify the spatial and temporal variations of bed load transport rate at the individual particle scale.

Keywords: Bedload transport; Particle tracking; Particle velocity

1 Introduction

Accurately calculating bedload transport rates has been a challenge in hydraulic engineering for decades. Bed load transport depends on the interaction between flow and sediment particles (Bridge & Dominic, 1984). Determining the velocity of sediment particles on a river bed is essential to quantify the transport rate. Many researchers (Bridge & Dominic, 1984; Francis, 1973; Lee & Hsu, 1994; Niño & García, 1994a; Novak & Nalluri, 1975; Sekine & Kikkawa, 1992) have studied the characteristics of particle motion and velocity. For example, images from high-speed cameras have enabled the accurate measurement of individual sediment motion (Francis, 1973;

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