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A new method for measurement of debris flow surface velocity fields

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Velocity and its spatiotemporal variation are important for debris flow dynamics. This paper presents a new method, the trace projection transformation, for accurate, non-contact measurement of surface velocity field of debris flow based on a combination of dense optical flow and perspective projection transformation. The algorithm for interpreting and processing was implemented in C++ and realized in Visual Studio 2012. The method allows quantitative analysis of flow motion through videos taken from various angles (camera positioned at the opposite direction of fluid motion). It yields the spatiotemporal distribution of surface velocity field at the pixel level and thus provides quantitative description of surface dynamic processes. The trace projection transformation is superior to the conventional measurement methods in that it obtains the full surface velocity field by computing the optical flow of all the pixels. The result achieves the accuracy of 90% by comparing with the observed values. Applying the method to surface velocity field measurement on one specific section exhibited evident advantages in quantitative analysis of surface velocity field variations.