

## ADAPTIVE AUTHENTICATION SCHEMES FOR 3D MESH MODELS

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**ABSTRACT.** *With the rapid development of computer technology and the increasing attractiveness of the 3D model, the 3D model has been applied widely in many different fields, such as engineering, medicine, entertainment, etc. Thus, security threats to 3D models must be seriously considered. Many researchers have proposed solutions to security issues with cryptography and still images. However, they are unsuitable for 3D models, because of the 3D models' special characteristics. In this paper, we propose two schemes to solve the problem of authentication in 3D mesh models. First, our schemes can detect and locate any unauthorized modification precisely. Second, both schemes have the features of being public and having the short key. Third, the distortion is controllable and is proven to be  $k_1/3$  on average, where  $k_1$  is a key specified by users. In addition, after being slightly modified, both schemes can deal with point-sampled geometry and be robust to affine transformations.*

**Keywords:** 3D models, Fragile watermarking, 3D (mesh) model authentication, Tamper detection, Distortion control

**1. Introduction.** Owing to the rapid improvements of computer technology and the attractive characteristics of three-dimensional (3D) models, the application of 3D models have greatly increased in the fields of engineering, medicine, entertainment and so on. Thus, works represented by 3D models have become an epidemic in recent years. The same as all the digital works, 3D models are convenient to store, modify, duplicate and transmit. However, this convenience has brought about many security threats. Hence, the copyright protection and authentication of digital works deserve serious consideration.

Many sophisticated solutions have been proposed for the security issues in Cryptography [1-4]. However, most of the solutions are based on abstruse mathematics, which make them time consuming and difficult to understand. In addition, cryptographic encryption does not thoroughly protect the work because it can still be harmed after decryption.

Watermarking is the art of imperceptibly embedding information into the original work. Because there is a limit to the sensitivity of human beings' sensory organs, such as the eyes and the ears, we have difficulty noticing the subtle changes made to multimedia works. Hence, watermarking takes advantage of this characteristic to overcome some security threats. As a new kind of multimedia, 3D models are also suitably protected by watermarking. Until recent years, the majority of the proposed schemes for the field of watermarking have focused on still images [5-12]. Arising from the widespread application of 3D models, the technologies for 3D watermarking have gradually attracted more attention.

Most of the concepts and terminologies of 3D model watermarking are similar to those of still image watermarking. The original model, which will be protected and has not been