# Computer Graphics and VR/AR: From Clouds, to Cartoons, to a 3-D Virtual Museum

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*Associate Editor-in-Chief Richard Zhang outlines published articles in this regular queue issue.*

The current issue features six articles from our regular queue that cover a range of topics in computer graphics and VR/AR, including object tracking, shape deformation, GPU acceleration, and lighting and illumination.

## IN THIS ISSUE

Two of the articles in this issue are concerned with lighting and illumination in outdoor scenes. In "Deep Synthesis of Cloud Lighting," the authors take a data-driven approach to synthesize clouds, aiming to obtain realistic outdoor lighting conditions beyond those under clear blue skies. Their method is trained on a collection of captured high dynamic range cloudy sky imageries, combined with clear-sky models, to produce plausible cloud appearance and lighting, while allowing artist control. In "Predicting Surface Reflectance Properties of Outdoor Scenes Under Unknown Natural Illumination," the authors propose a complete framework, based on phenomenological and physics-based scattering models, to predict surface reflectance properties in outdoor scenes under unknown natural illumination. Their key idea is to recast the reflectance prediction problem into its two core components involving the bidirectional reflectance distribution function of incoming light and outgoing view directions.

In "Keypoint-Based Disentangled Pose Network for Category-Level 6-D Object Pose Tracking," the authors address a challenging problem in three-dimensional (3-D) vision, category-level 6-D pose tracking. The key novelty of this work is to disentangle translation and rotation estimations using a keypoint-based approach, whereby the translation is directly estimated by a neural network and the rotation is indirectly calculated via singular value decomposition operating on the keypoints.

To address one of the most classical problems in real-time graphics, collision detection, the authors of the article "GPU-Accelerated Collision Analysis of Vehicles in a Point Cloud Environment" provide both theoretical accuracy bounds and a practical, GPU-accelerated volumetric Minkowski sum algorithm for collision analysis involving vehicle navigation in a 3-D environment represented by point clouds. An interesting feature of their approach is that it performs adaptive and efficient collision of voxels, which represent the vehicles, with the point cloud without the need for mesh generation.

Finally, on the modeling side, two articles on shape deformation and VR/AR round up this queue issue. In "Digitizing Wildlife: The Case of a Reptile 3-D Virtual Museum," a VR/AR system is designed with holistic metadata documentation and a variety of reptile behaviors and movements that can be showcased in a 3-D museum. VR and AR displays serve as interactive educational tools that are available to the public domain. Of particular interest is the important information regarding reptiles' behavior and other intangible characteristics. In the article "View-Dependent Deformation for 2.5-D Cartoon Models," the authors introduce view-dependent deformation, which had been employed for 3-D character animation, into 2.5-D cartoon models for simulating 3-D movements, such as out-of-plane rotation, from 2-D shapes in different views. One key feature of their method lies in how to handle cartoon exaggerations that do not correspond to any realistic 3-D objects. Specifically, the exaggerations in an arbitrary viewpoint are automatically obtained by blending the user-specified 2-D shapes of key views. In addition to comparisons to previous methods, a user study was conducted to confirm the efficacy of their method in animating classic cartoon characters.

0272-1716 © 2022 IEEE
Digital Object Identifier 10.1109/MCG.2022.3201455
Date of current version 3 October 2022.

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