Fact Sheet – Technical Papers

Chair : Peter-Pike Sloan, NVIDIA Corporation, USA
Conference : Wednesday 28 November – Saturday 1 December 2012
Exhibition : Thursday 29 November – Saturday 1 December 2012

The SIGGRAPH Asia 2012 Technical Papers program is a premier international forum for presenting new research results in computer graphics and interactive techniques. All papers appear in the journal ACM Transactions on Graphics (TOG). Leading international experts from all over the world present the best results in peer-reviewed research spanning a wide range of research areas.

Fast Facts

The SIGGRAPH Asia 2012 Technical Papers program received a healthy number of 326 submissions. Of these, a total of 77 papers were conditionally accepted. This is an acceptance rate of 23 percent, similar to SIGGRAPH's average acceptance rate. These papers were chosen by the Papers Committee based on the importance of the problem being solved, the impact and potential of each paper, and its technical strength and rigor. The high number of submissions this year demonstrates the recognition of the Technical Papers program at SIGGRAPH Asia and SIGGRAPH as a premier venue to demonstrate scientific excellence, innovation and novelty in graphics and interactive techniques. The Papers Committee has selected an exciting program of papers that will contribute significantly to advancing the field.

Quote from the SIGGRAPH Asia 2012 Technical Papers Chair, Peter-Pike Sloan, NVIDIA Corporation, USA

"The SIGGRAPH Asia Technical Papers program adheres to the highest scientific standards and this year is no different. Accepted papers are from all over the world, and the broad set of topics covered includes rendering, motion-capture, stereoscopy and fluid-simulation, among others. As always, excellence of the ideas is the predominant criterion for selecting this outstanding set of papers."

SIGGRAPH Asia 2012 Technical Papers highlights

- ***SURE-based Optimization for Adaptive Sampling and Reconstruction***
  Tzu-Mao Li, Yu-Ting Wu, and Yung-Yu Chuang, National Taiwan University

This paper introduces Stein's Unbiased Risk Estimator (SURE) into the framework of adaptive sampling and reconstruction to reduce noise in Monte Carlo rendering. SURE is a general unbiased estimator for mean squared error (MSE) in statistics. With SURE, errors within an arbitrary reconstruction kernel are estimated, enabling more effective kernels to be used rather than restricting to symmetric ones used in previous work. It also allows more samples to be allocated for areas with higher estimated MSE. Adaptive sampling and reconstruction can therefore be processed in an optimization manner. A more efficient and memory friendly approach is proposed to reduce the impact of corrupted geometry features where depth of field or motion blur occurs.

This method is robust enough to handle all types of distributed effects, and produces images with less noise and crisper details than other state-of-the-art methods.

- ***Elasticity-Inspired Deformers for Character Articulation***
  Ladislav Kavan and Olga Sorkine, ETH Zurich

This paper will present a closed-form skinning method that approximates nonlinear elastic deformations well while remaining very fast. Skinning weights are optimized for the standard linear and dual quaternion skinning techniques so that the resulting deformations minimize an elastic energy function. This is not sufficient to match the visual quality of the original elastic deformations, so a new skinning method based on the concept of joint-based deformers is proposed, similar to nonlinear variational deformation methods. The final algorithm is fully automatic and requires no input from the user other than a rest-pose mesh and a skeleton. The runtime complexity requires minimal memory and computational overheads compared to linear blend skinning, while producing higher quality deformations than both linear and dual quaternion skinning.

- ***Motion-Guided Mechanical Toy Modelling***
  Weiwei Xu, Hangzhou Normal University
  Lifeng Zhu and Guoping Wang, Department of Computer Science, Peking University
  Yang Liu and Baining Guo, Microsoft Research Asia
  John Snyder, Microsoft Research

This paper presents a new method to synthesize mechanical toys solely from the motion of their features. The designer specifies the geometry and a time-varying rotation and translation of each rigid feature component. The new algorithm automatically generates a mechanism assembly located in a box below the feature base that produces the specified motion.

Parts in the assembly are selected from a parameterized set including belt-pulleys, gears, crank-sliders, quick-returns, and various cams (snail, ellipse, and double-ellipse). Positions and parameters for these parts are optimized to generate the specified motion, minimize a simple measure of complexity, and yield a well-distributed layout of parts over the driving axes. The solution uses a special initialization procedure followed by simulated annealing to efficiently search the complex configuration space for an optimal assembly.

- ***Coherent Intrinsic Images from Photo Collections***
  Pierre-Yves Laffont, Adrien Bousseau, and George Drettakis, REVES/INRIA Sophia-Antipolis
  Sylvain Paris, Adobe Systems
  Fredo Durand, MIT CSAIL

This paper proposes the computation of intrinsic decompositions using several images of the same scene under different viewpoints and lighting conditions. Using multi-view stereo, 3D points and normals are automatically reconstructed, bringing new relationships between reflectance values at different locations, across multiple views and consequently different lighting conditions. Robust estimations are used to reliably identify reflectance ratios between pairs of points. From these, constraints for our optimization are used to enforce a coherent solution across multiple views and illuminations. Results demonstrate that this constrained optimization yields high-quality and coherent intrinsic decompositions of complex scenes. This paper illustrates how these

decompositions can be used for image-based illumination transfer and transitions between views with consistent lighting.

- ***Example-based Synthesis of 3D Object Arrangements***
  Matthew Fisher, Daniel Ritchie, Manolis Sawa, and Pat Hanrahan, Stanford University
  Thomas Funkhouse, Princeton University

This paper will present a method for synthesizing 3D object arrangements from examples. The algorithm can synthesize a diverse set of plausible new scenes given only a few examples and requires no additional inputs from the user. These capabilities are enabled by three novel contributions. First, a probabilistic model for scenes based on Bayesian networks and Gaussian mixtures is introduced that can be trained from a small number of input examples. Second, a clustering algorithm is developed that groups objects occurring in a database of scenes according to their local scene neighborhoods. These contextual categories allow the synthesis process to treat a wider variety of objects as interchangeable. Third, the probabilistic model is trained on a mix of user-provided examples and relevant scenes retrieved from the database. This mixed model learning process can be controlled to introduce additional variety into the synthesized scenes. The resulting algorithm is evaluated through qualitative results and a perceptual study in which participants judged synthesized scenes to be highly plausible, as compared to hand-created scenes.

- ***Correcting for Optical Aberrations using Multilayer Displays***
  Fu-Chung Huang and Brian Barsky, University of California, Berkeley
  Douglas Lanman and Ramesh Raskar, MIT Media Lab

Optical aberrations of the human eye are currently corrected using eyeglasses, contact lenses, or surgery. This paper describes a fourth option: modifying the composition of displayed content such that the perceived image appears in focus, after passing through an eye with known optical defects. Prior approaches synthesize pre-filtered images by deconvolving the content by the point spread function characterizing the aberrated eye. Such methods have not yet led to practical applications, since processed images exhibit severely reduced contrast and ringing artifacts. In this paper, these limitations are addressed by introducing multilayer pre-filtering, implemented using stacks of semi-transparent, light-emitting layers. By optimizing the layer positions and the partition of spatial frequencies between layers, contrast is improved and ringing artifacts are eliminated. Design constraints are assessed that must be met by multilayer displays; emerging autostereoscopic light field displays are identified as a preferred, thin form factor architecture, allowing synthetic layers to be displaced in response to viewer movement and changes in refractive errors. The benefits of multilayer pre-filtering vs. related light field pre-distortion methods are formally assessed, showing pre-filtering works within the constraints of current display resolutions. The paper concludes by analyzing practical benefits and limitations using a custom-built multilayer LCD prototype.

- ***Accurate Realtime Full-body Performance Capture Using a Single Depth Camera***
  Xiaolin Wei, Peizhao Zhang, and Jinxiang Chai, Texas A&M University

This paper will present a fast automatic method for accurately capturing full-body performance using a single depth camera. At the core of the new system lies a real-time tracking process that can reconstruct the 3D poses even under significant occlusions. The idea is to formulate the tracking problem in a Maximum A Posteriori (MAP) framework and iteratively register the 3D reconstructed poses with depth data via linear system solvers. The 3D tracking process, however,

requires manual initialization and recovery. This limitation is addressed by combining with 3D pose detection. This combination not only automates the whole process but also significantly improves the robustness and accuracy of the system. The paper's proposed algorithm is highly parallel and is therefore easily implemented on a GPU. This prototype system can run up to 44 frames per second. The power of this approach is demonstrated by capturing a wide range of human movement to achieve state-of-the-art accuracy in a comparison with Microsoft Kinect.

- ***Large-Scale Fluid Simulation using Velocity-Vorticity Domain Decomposition***
  Abhinav Golas, Krajcevski Pavel, and Ming Lin, University of North Carolina at Chapel Hill
  Rahul Narain, University of California, Berkeley
  Jason Sewall and Pradeep Dubey, Intel Corporation

Simulating fluids in large-scale scenes with appreciable quality using state-of-the-art methods can lead to high memory and compute requirements. Since memory requirements are proportional to the product of domain dimensions, simulation performance is limited by memory access, as kernels involved are not compute intensive. This is a significant concern for large-scale scenes. To reduce the memory footprint and memory/compute ratio, vortex singularity bases can be used. Though they form a compact bases for incompressible vector fields, robust and efficient modeling of non-rigid obstacles and free-surfaces can be challenging with these methods.

This paper proposes a hybrid domain decomposition approach that couples Eulerian velocity-based simulations with vortex singularity simulations. The proposed formulation reduces the memory footprint by using smaller Eulerian domains with compact vortex bases, thereby improving the memory/compute ratio, and simulation performance. Coupling these two heterogeneous methods also affords flexibility in using the most appropriate method for modeling different scene features, as well as allowing robust interaction of vortex methods with free-surfaces and non-rigid obstacles.