Technical Briefs Fact Sheet

Chair: Baoquan Chen, Shenzhen Institute of Advanced Technology, China
Co-Chair: Andrei Sharf, Ben Gurion University, Israel
Conference: Tuesday 19 November – Friday 22 November
Exhibition: Wednesday 20 November – Friday 22 November

Fast Facts

- At SIGGRAPH Asia, the Technical Briefs program is a platform where international experts from over the world present their results in peer-reviewed research spanning a wide range of research areas.
- This year, the Technical Briefs programs will present research findings on topics such as geometric modeling, animation, image processing, mixed media, GPUs, and more.
- The Technical Briefs program received 75 submissions this year.
- A total of 33 submissions were accepted from over 18 countries and regions around the world, making this a healthy acceptance rate of 54.50% of the submissions received.
- 13 submissions were accepted from Asian countries such as China, Hong Kong, Japan, and Singapore.

A Quote from the SIGGRAPH Asia 2013 Technical Briefs Chair and Co-Chair:

"Returning after a successful introduction at SIGGRAPH Asia last year, the Technical Briefs program continues to be a platform for sharing new international research results. This year, the attendees will see a diverse range of research topics presented in Hong Kong, ranging from traditional computer graphics to mixed media, interactive techniques, and GPUs. Attendees will be mainly inspired by novel works-in-progress and fresh ideas just out of development and the experimental pipeline."

SIGGRAPH Asia 2013 Technical Briefs Program Highlights

- **Stochastic Modeling of Immersed Rigid-body Dynamics**
  Haoran Xie and Kazunori Miyata, Japan Advanced Institute of Science and Technology

  The simulation of immersed rigid-body dynamics involves the coupling between objects and turbulent flows, which is a complicated task in computer animation. This paper will propose a stochastic model of the dynamics of rigid bodies immersed in viscous flows to solve this problem. First, the attempt is to modulate the dynamic equations of rigid bodies using generalized Kirchhoff equations (GKE). Then, a stochastic differential equation called the Langevin equation is proposed to represent the velocity increments due to the turbulences. After the pre-computation of the Kirchhoff tensor and the kinetic energy of a synthetic turbulence are induced by the object moving, a fractional-step method is applied to solve the GKE with vortical loads of drag and lift dynamics in runtime. The resulting animations include both inertial and viscous effects from the surrounding flows for arbitrary geometric objects. This model is coherent and effective to simulate immersed

rigid-body dynamics in real-time.

- **Example-Based Art Pattern Synthesis Using Level Sets**
  Ruobing Wu, Wenping Wang, and Yizhou Yu, The University of Hong Kong

  Line drawings and digital arts appear everywhere, from simple icons and logos to cartoons, maps, and illustrations. Art patterns are defined as the subset of line drawings and digital arts that are comprised of repeated elements. In this paper, the focus will be on synthesizing art patterns with curvilinear features from exemplars, which will then be cast as a global optimization problem. The energy function for this problem measures both the appearance similarity of color patterns and shape similarity of curvilinear features between an input exemplar and a synthesized image. Then, an overall EM-style algorithm for minimizing this energy function is developed. The shape similarity part of the energy is minimized through an innovative application of the level set method. The energy function and optimization algorithm are then further generalized to multi-layer pattern synthesis. This generalized optimization is able to effectively handle multiple layers and synthesize valid instances of interaction.

- **Mining Effective Parallelism from Hidden Coherence for GPU Based Path Tracing**
  Tong Wang and Yangdong Deng, Tsinghua University

  As one of the essential global illumination algorithms, Monte Carlo path tracing has long been considered as a typical irregular problem that is less friendly for graphics hardware. To improve the efficiency of Monte Carlo path tracing, techniques such as ray reordering, ray compaction, and wavefront formulation have been proposed to exploit the inherent coherence in processing different paths and materials for better SIMD efficiency on GPUs. This paper will propose a novel technique to extract extra parallelism in Monte Carlo path tracing applications by identifying hidden coherence. The basic idea is to perform a partial traversal in the fast on-chip memory of GPU and then identify coherent paths by analyzing the traversal results as well as other features of rays. Such coherence enables a higher level of parallelism that not only compensates the overhead of traversal, but also leads to improved performance.

- **Importance Sampling for Physically-Based Hair Fiber Models**
  Eugene Deon and Johannes Hanika, Weta Digital
  Steve Marschner, Cornell University

  This paper will present an importance sampling scheme for physically-based hair fiber reflectance models. The sampling scheme is closely tied to the original derivation of physically-based fiber functions and supports lobe selection and efficiently samples the complex caustic shapes of lobes like TRT. The scheme is easy to implement and requires no pre-tabulation, allowing fully heterogeneous variations of all fiber parameters within any given hair volume.

- **Decolorization: Is rgb2gray() Out?**
  Yibing Song, Linchao Bao, Xiaobin Xu, and Qingxiong Yang, City University of Hong Kong

  The decolorization problem originates from the fact that the luminance channel may fail to

represent structures or contrasts in the original color image, especially for iso-luminant regions. Various techniques have been employed to solve the problem, though all of the existing methods suffer from the same weakness - robustness. Failed cases can be easily found for each of the methods. This prevents all these methods from being practical for real-world applications. In fact, the simplest method like the rgb2gray() function in Matlab, which produces grayscale images through linear combination of R, G, and B channels with fixed weights, turns out to perform rather well in practice, only with exceptions for few failed cases like occasional iso-luminant images. Thus a thought-provoking question is naturally raised: can we reach a robust solution by simply modifying the rgb2gray() to avoid failures in iso-luminant regions? For example, instead of assigning fixed channel weights for all images, a more flexible strategy would be choosing channel weights depending on specific images to avoid indiscrimination in iso-luminant regions. Following this strategy, by considering multi-scale contrast preservation in both spatial domain and range domain, an algorithm is designed to consistently produce several "good" results for each input color image, among which the actual "best" one preferred by users can be selected by further involving perceptual contrasts preferences depending on specific applications. These results are then verified through user studies.

- **Cross-sectional Structural Analysis for 3D Printing Optimization**
  Nobuyuki Umetani and Ryan Schmidt, Autodesk Research

  This paper will propose a novel cross-sectional structural analysis technique that efficiently detects critical stress inside a 3D object. The object is then sliced into cross-sections and stress is computed based on bending momentum equilibrium. Unlike traditional approaches based on finite element methods, this method does not require a volumetric mesh or solution of linear systems, enabling interactive analysis speed. Based on the stress analysis, the orientation of an object is optimized to increase mechanical strength when manufactured with 3D printing.

- **Information-Geometric Lenses for Multiple Foci + Contexts Interfaces**
  Richard Nock, Université des Antilles et de la Guyane
  Frank Nielsen, Sony CSL

  We present a new set of 2D/3D modeling and visualization techniques that build upon recent information geometric works, with desirable properties like seamless multiple foci + contexts abilities, several keeping of meaningful topological features and tangible shapes, and a very good Euclidean approximation near the focus, which make them reliable candidates to display (geographic) maps or pictures.

  This paper will also show that a slight modification of a popular fisheye view, namely Sarkar-Brown's, belongs to this set. A report on two experiments on 2D and 3D interfaces against contenders from hyperbolic geometry will be then be discussed. Essentially, it is a browsing task involving a real-world virtual library, whose map is a manifold learned from the traces of over 60,000 users, and consisting of approximately 10,000 books. Observations and users' feedback suggest that information geometry makes a sound alternative to hyperbolic geometric approaches, and may help to craft appealing geometric focus + context interfaces tailored to specific displays or domains.

- **Improving Robustness of Monte-Carlo Global Illumination with Directional Regularization**
  Guillaume Bouchard, Jean-Claude Lehl, and Victor Ostromoukhov, Université de Lyon
  Pierre Poulin, Université de Montréal

  Directional regularization offers great potential to improve the convergence rates of Monte-Carlo-based global illumination algorithms. This paper will demonstrate how it can be applied successfully by combining unbiased bidirectional strategies, photon mapping, and biased directional regularization.

Full information about the Technical Papers program can be found on http://sa2013.siggraph.org/en/attendees/technical-briefs.html.

For more information about SIGGRAPH Asia 2013 program updates, please visit http://sa2013.siggraph.org.