Workshop: Data-Driven Animation Technology (D2AT)

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CCS CONCEPTS

• **Computing methodologies → Animation**;

KEYWORDS

Data-driven, motion data, emotion data, machine learning

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1 INTRODUCTION

The aim of this full-day workshop in conjunction with SIGGRAPH Asia 2017 is to bring together researchers from diverse backgrounds, such as computer graphics, computer vision, virtual reality, human computer interactions and machine learning, with a common interest in data-driven, realistic animation. Interests in this emerging topic may stem from a variety of sources, e.g. point cloud data collected from laser scanners or RGBD cameras such as KINECT, high resolution geometry reconstructed by Structure from Motion (SfM), motion capture devices including high frame-rate optical trackers and IMUs, GPS data from millions of mobile devices etc. Despite the high dimensionality and the huge volume of the dataset, the boost in machine learning and big data technologies are allowing researchers to extract important features from them for which can be applied for data analysis, synthesis and editing.

This workshop delivers attendees the latest approaches for data acquisition, data processing, feature extraction, data analysis, and synthesis for applications in computer graphics and animation. Moreover, we bring together people from computer graphics, computer animation, computer vision, big data analysis and machine learning to create a synergy of applying machine learning techniques for animation production. We call for high quality works that fall into the topics of data-driven techniques for computer graphics and animation. Novel ideas and results are highly welcome even if they are in a preliminary stage. We are also interested in papers that discuss existing techniques applied in a novel context.

(1) data-driven character animation,
(2) data-driven cloth animation,
(3) data-driven hair animation,
(4) data-driven fluid animation,
(5) data-driven facial animation,
(6) data-driven motion editing,
(7) data-driven motion retargeting and synthesis,
(8) data-driven physics-based animation,
(9) data-driven techniques for virtual reality/augmented reality applications,
(10) machine learning techniques for computer animation,
(11) machine learning techniques for non-photo realistic rendering,
(12) machine learning techniques for character control,
(13) machine learning techniques for human computer interaction,
(14) video-based human motion analysis and tracking,
(15) image/video-based facial recognition,
(16) image/video-based human localization,
(17) image/video-based 3D reconstruction, and
(18) statistical, structural or syntactic pattern recognition methods for methods for motion analysis and synthesis.

2 PRESENTED PAPERS

- **Motion Style Extraction Based on Sparse Coding Decomposition**
  Thanh Nguyen Xuan, Ha Le Thanh and Yu Hongchuan
  We present a sparse coding-based framework for motion style decomposition and synthesis. Dynamic Time Warping is firstly used to synchronized input motions in the time domain as a pre-processing step. A sparse coding-based decomposition has been proposed, we also introduce the idea of core component and basic motion. Decomposed motions are then combined, transfer to synthesize new motions. Lastly, we develop limb length constraint as a postprocessing step to remove distortion skeletons. Our framework has the advantage of less time-consuming, no manual alignment and large dataset requirement. As a result, our experiments show smooth and natural synthesized motion.

- **Manage surface effects in generating new motion for body and face based on dictionary learning**
  Nguyen Khiem and Yu Hongchuan
  We propose a method to allow user control the suface effect that relates to skin and muscle deformation in combination motion from multiple body parts in animation. This method is closely based on the theory of sparse matrix decompositions as well as the single value decomposition (SVD) of

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Principal Compent Analysis (PCA) method to 3D mesh sequence processing. The dimension in 3D mesh sequence is extracted into meaningful components, then analysized into some features such as shape, motion that includes skin and muscle deformation. Our method is flexible that allows users choose any body parts of models from two or more different motion sequences to combine together. It will help user generate new dynamic motion included surface effects. The capabilities of our verstatile and comfortable method are extensively applied on different datasets such as facial motion and body motion that has same mesh topology for all of frames in sequence. We do some expriments that perform the synthezed, blended shape and retarget motion into another shape. For facial expression, we also demonstrate how surface deformation from each facial feeling takes part in the mixed result as well as how impressive of skin and muscle effect from original smoods perform into blend face.

- **Data-Driven Approach for Simulating Brittle Fracture Surfaces**
  Yonghang Yu, Yuhang Huang and Takashi Kanai
  In this paper, we propose a novel data-driven method that uses a machine learning scheme for formulating fracture simulation with the Boundary Element Method (BEM) as a regression problem. With this method, the crack-opening displacement (COD) of every correlation node is predicted at the next frame. In our naïve prediction, we design a feature vector directly exploiting stress intensities and toughness at the current frame, so that our method predicts the COD at the next frame more reliably. Thus, there is no need to solve the original linear BEM system to calculate displacements. This enables us to propagate crack-fronts using the estimated stress intensities. There are existing works which use the machine learning approach to accelerate the speed of traditional physics-based simulations like smoke and fluid, but our work is the first to incorporate the machine learning scheme into BEM-based fracture simulations. Our implementation accelerates the acquisition of displacements in linear time over the number of crack-fronts at each time step compared with the conventional solution whose time complexity grows exponentially based on the BEM linear system.

- **Synthesizing Motion with Relative Emotion Strength**
  Edmond S. L. Ho, Hubert P. H. Shum, He Wang and Li Yi
  With the advancement in motion sensing technology, acquiring high-quality human motions for creating realistic character animation is much easier than before. Since motion data itself is not the main obstacle anymore, more and more effort goes into enhancing the realism of character animation, such as motion styles and control. In this paper, we explore a less studied area: the emotion of motions. Unlike previous work which encode emotions into discrete motion style descriptors, we propose a continuous control indicator called motion strength, by controlling which a data-driven approach is presented to synthesize motions with fine control over emotions. Rather than interpolating motion features to synthesize new motion as in existing work, our method explicitly learns a model mapping low-level motion features to the emotion strength. Since the motion synthesis model is learned in the training stage, the computation time required for synthesizing motions at run-time is very low. As a result, our method can be applied to interactive applications such as computer games and virtual reality applications, as well as offline applications such as animation and movie production.

- **Character Motion Adaptation to Novel Geometry**
  Rami Al-Ashqar, Xi Zhao and Taku Komura
  We propose a method to adapt motion data of interactions with respect to a template object to novel objects, such as a character manipulating a tool or navigating a restricted environment and avoiding obstacles. Although various methods for hallucinating scenes are proposed, all previous methods only adapt a single pose and not the entire motion. The animation will become discontinuous if such methods are applied to adapt every posture during the motion to novel geometries. In this paper, we cope with this problem by applying the relationship descriptors that describe the motion data by a weighted sum of relative vectors originating from descriptor points embedded in the scene. Our method first assumes a co-analysis between the template and novel objects which are co-segmented such that a rough correspondence between objects with different geometry are established. We then analyse open space features surrounding the novel object to determine candidate points for warping a representative posture of the character in the animation to the novel geometry and use that to embed the relationship descriptors in the surface of the novel geometry. The relative vectors originating from the new locations of the descriptor points combined with the motion warping scheme will generate a continuous motion of the character interacting with the environment that preserves the original context and style. Our method can be applied for animation production and character control in realtime applications such as computer games given the co-analysis is precomputed.

- **Learning components of Sparse PCA for motion style transfer**
  Phong Do, Hongchuan Yu and Thanh Nguyen
  Automatically precise stylization of human motion to express mood is a primary role in realistic humanoid animation. Many approaches have been developed for this style transfer task and most of them are data-driven one. The drawbacks of those are large dataset requirement and the time-consuming period for training model. In this paper, we propose a novel method applied successfully for a small emotion-motion dataset. Our method consists of three main steps. Firstly, two motions are deformed into smaller components using Sparse PCA. After that, the learning process will adjust white noise components in order to synthesize content and style of input motions before generating the transferred motion data. The experiments conducted on Emotional Body Motion Dataset exert promising results as the motion is correct and smooth, and the emotion is shown explicitly.

- **Parallel Bag-SVM-SGD for classifying very high-dimensional and large-scale multi-class datasets**
  Thanh-Nghi Do, Nguyen-Khang Pham, The-Phi Pham, Minh-Thu Tran-Nguyen and Huu-Hoa Nguyen
  We propose the parallel bagging support vector machines using stochastic gradient descent (Bag-SVM-SGD) on multicore computers for effectively classifying very-high-dimensional and large-scale multi-class datasets. The Bag-SVM-SGD learns in a parallel way from under-sampling training dataset to create ensemble binary SVM-SGD classifiers used in the One-Versus-All (OVA) multi-class strategy for performing text/image classfication tasks with million of datapoints in millions of dimensions and thousands of classes. The numerical test results on four large scale multi-class datasets (ImageNet, LSHTC4, Book) show that our Bag-SVM-SGD algorithm is faster and more accurate than the state-of-the-art linear algorithm LIBLINEAR. An example of its effectiveness is given with an accuracy of 62.41% obtained in the classification of LSHTC4 dataset having 728,067 datapoints in 1,617,900 dimensions into 2,713 classes in 104.15 minutes using a PC Intel(R) Core i7-4790 CPU, 3.6 GHz, 4 cores.

- **Creating Generic Data-driven Face Rigs for Digital Actors**
  Volker Helzle, Kai Goetz and Diana Arellano
  The creation of faces for digital actors is a time-consuming and challenging process, especially when the character to recreate is a not living one, or looks very different to the original counterpart (e.g. aged). One crucial element is the facial rig, which can facilitate, or hinder the subsequent animation process. In this paper we present the Adaptable Facial Setup (AFS), an easy-to-use, semi-automatic rigging solution that uses a generic database of facial motion data to drive facial animation. To prove the reliability of our approach, and how it helps to overcome the challenges when creating historical characters, we created a digital version of Albert Einstein's head. The resultant animations created with our AFS facial rig and a blendshape rig were compared through a user perception evaluation, corroborating that our approach leads to more convincing and natural facial animation.

- **High Quality Compatible Triangulations for Planar Shape Animation**
  Zhiguang Liu, Liuyang Zhou, Howard Leung, Franck Multon and Hubert P. H. Shum
  We propose a new method to compute compatible triangulations of two polygons in order to create a smooth geometric transformation between them. Compared with existing methods, our approach creates triangulations of better quality, that is, triangulations with fewer long thin triangles and Steiner points. This results in visually appealing morphing when transforming the shape from one to another. Our method consists of three stages. First, we use the common valid vertex pair to uniquely decompose the source and target polygons into pairs of sub-polygons, in which each concave sub-polygon is triangulated. Second, within each sub-polygon pair, we map the triangulation of a concave sub-polygon onto the corresponding sub-polygon using linear transformation, thereby generating compatible meshes between the source and the target. Third, we refine the compatible meshes, which can create better quality planar shape morphing with detailed textures. Experimental results show that our method can create compatible meshes of higher quality compared to existing methods with fewer long thin triangles and smaller triangle deformation values during shape morphing. These advantages enable us to create more consistent rotations for rigid shape interpolation algorithm and facilitate a smoother morphing process. The proposed algorithm is robust and computationally efficient. It can be applied to produce convincing transformations such as interactive 2D animation creation and texture mapping.

- **Crowd Simulation Using Deep Leaning and Agent Space Heat Maps**
  Masaki Oshita and Yasutaka Honda
  We propose a novel method of crowd simulation that employs a deep learning technique for controlling individual agents. We use an autoencoder to learn agent space heat maps that are generated from example crowd animations. A heat map contains the positions of nearby agents and the temporary target position that indicates an appropriate heading direction for the agent to reach the final target position efficiently. In the control of an agent, an agent space heat map that contains possible temporary target positions is estimated from the trained model and the agent space heat map that contains only the positions of nearby agents. Individual agents are controlled so that they move toward the estimated temporary target position. We present our experimental results and discuss the advantage of our approach.

- **Frozen Shoulder Exercise Simulation for Treatment Support**
  Nuntiya Chiensriwimol, Azri Noah, Nazri Osman, Pornchai Mongkolnam and Jonathan Chan
  Frozen shoulder treatment is normally a time-consuming process. Continual physical therapy is required in practice to gradually improve a patient to be better. Nowadays, there are increasing number of smartphone applications developed to facilitate patients to perform tele-rehabilitation. In this study, we focus on improving biofeedback data to be more useful on treatment process by animating arm movement in various exercise types via a mobile app. The main contribution of this paper is to simulate the frozen exercise using a Unity 3D model. The results found that our mobile app and the web back-end can help the physiotherapist to easily monitor a patient's rehabilitation.

- **Human Silhouette Feature Extraction using 3D Point Cloud**
  Kripesh Adhikari, Hammadi Nait-Charif and Hamid Bouchachia
  This paper aims to upgrade the human feature extraction process discussed in [?] replacing 2D RGB and Depth images from Kinect sensor with 3D Point Cloud images. The idea of using point cloud images is to take the advantage of

key information such as X,Y,Z locations and intensities of each channel R, G and B for better feature extraction. These features can then be used further for many other applications such as object detection, recognition and tracking. We aim to use point cloud data in a convolutional neural network as in [?] for improving the accuracy of the model to recognise human pose in the future. In this paper, we will be discussing mainly on data acquisition technique to use point cloud images from Kinect that can reduce the computational cost and complexity for other techniques. Other than that, background subtraction is performed on 3d point cloud images to extract human silhouette. Since the background subtraction technique is not robust enough to detect only human silhouette in the 3D Point Cloud, we implemented RANSAC algorithm to extract human silhouette features from the point cloud data. We are in the preliminary stage of testing the RANSAC Algorithm to acquire inliers that can represent human silhouette only and process these particular points to the Convolutional Neural Network.

3 CO-CHAIRS OF WORKSHOP D2AT

- Dr Hongchuan Yu
- Dr Taku Komura
- Prof Jian J Zhang