

Annual Report for Period:09/2006 - 08/2007

Submitted on: 07/27/2007

Principal Investigator: Prabhakaran, Balakrishnan .

Award ID: 0237954

Organization: U of Texas Dallas

Title:

CAREER: Animation Databases

Project Participants

Senior Personnel

Name: Prabhakaran, Balakrishnan

Worked for more than 160 Hours: Yes

Contribution to Project:

B. Prabhakaran is the PI of the project. During this year, I graduated 3 PhD students and 4 Masters' thesis students who worked on various research issues pertaining to this project. Currently, I am supervising 4 PhD students and 3 Masters students in this research area.

Post-doc

Graduate Student

Name: Li, Chuanjun

Worked for more than 160 Hours: Yes

Contribution to Project:

Chuanjun Li developed Singular Value Decomposition (SVD) based similarity measure for content-based motion retrieval as well as motion classification/ metadata generation. He also used the SVD approach to train Support Vector Machines (SVMs) for fast motion classification. He has also developed an interval-based index structure for efficient content-based retrieval of 3D motions.

Chuanjun Li was supported as a Teaching Assistant by the Department of Computer Science as a matching support for the NSF project.

Chuanjun graduated with his Phd degree and is currently a post-doc at the Brown University.

Name: Li, Hui

Worked for more than 160 Hours: Yes

Contribution to Project:

Hui Li worked on his PhD thesis that focused on transmission of 3D models and animations over networks. He developed heuristics to support streaming of 3D models.

Hui Li was supported as a Teaching Assistant by the Department of Computer Science as a matching support for the NSF project.

Hui graduated as a PhD student and is current a Research Engineer at Ask.com

Name: Agarwal, Parag

Worked for more than 160 Hours: Yes

Contribution to Project:

Parag Agarwal is working on collision detection/resolution in animation authoring. He is developing heuristics to reduce the search-space for checking possible collisions.

Parag Agarwal was supported as an RA by the Dean's matching grant for the NSF grant. Parag expects to defend his PhD thesis in Fall 2007.

Name: Pradan, Gaurav

Worked for more than 160 Hours: Yes

Contribution to Project:

Gaurav Pradhan is working on indexing approaches for content-based motion comparison. He has developed an interval-tree based index structure that prunes irrelevant motions efficiently. He is being supported as a student assistant from the NSF grant and is working on his PhD thesis.

Name: Arun, Prakash

Worked for more than 160 Hours: Yes

Contribution to Project:

Arun Prakash completed his Masters dissertation on visualizing animation databases. He developed user interfaces that aid in visualizing the responses from animation databases.

Name: Li, Mng

Worked for more than 160 Hours: Yes

Contribution to Project:

Ming Li completed his PhD thesis on Quality of Service (QoS) support for wireless networks to aid in streaming 3D models and motions. He was supported as a Teaching Assistant of the Computer Science department, as a matching fund for the NSF career grant.

Ming is currently a tenure-track Assistant Professor at the California State University, Fresno.

Name: Adi, Ketaki

Worked for more than 160 Hours: Yes

Contribution to Project:

Ketaki implemented several Watermarking approaches for copyright protection of 3D motions.

Name: Naik, Sagar

Worked for more than 160 Hours: Yes

Contribution to Project:

Sagar Naik completed his Masters thesis on 3D model matching. He developed similarity measures that can compare 3D models.

Name: Tang, Ziyang

Worked for more than 160 Hours: Yes

Contribution to Project:

Ziyang Tang is currently working for her PhD dissertation. She is addressing the issues involved in using deformable 3D models in animations. These issues include streaming, and classification.

Name: Zhou, Junqiang

Worked for more than 160 Hours: Yes

Contribution to Project:

Junqiang is a PhD student co-supervised by me and another faculty. He is working on analyzing 3d motion capture camera placement problems and optimizing them for maximum coverage and reliability. He will also apply these results for 2D video camera placement and reliability.

Name: Pawar, Manoj

Worked for more than 160 Hours: Yes

Contribution to Project:

Manoj carried out Masters thesis work on creating a visual query interface for 3D motion capture databases. With this interface, users can draw simple actions that need to be part of the retrieved 3D motions.

Name: Ramaswamy, Vivekshankar

Worked for more than 160 Hours: Yes

Contribution to Project:

Vivek carried out his Masters thesis work on streaming animation scenes. He came up with scheduling algorithms that aid delivering 3D models comprising an animation in succession.

Name: Agrawal, Sameer

Worked for more than 160 Hours: Yes

Contribution to Project:

Sameer also did his Masters thesis work. This work was on streaming 3D models compressed using Progressive Forest Split (PFS). He exploited the characteristics of PFS that aid streaming.

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

The initial proposal was to carry out research activities on partial fuzzy query resolution, collision detection, model & motion comparison, segmentation, and querying. An animation toolkit was also proposed to be implemented. Of these, the following activities have been completed:

- a. Partial, fuzzy query resolution: result accepted as a research paper in the ACM Transactions on Multimedia, Computing, and Applications (TOMCCAP).
- b. Collision detection: research paper under going 2nd review for the Visual Computer journal.
- c. Segmentation & motion comparison: several research papers published, including one in ACM Transactions on Multimedia (TOMCCAP).

I felt we have completed major part of the proposal with significant publications in prestigious journals and conferences. Hence, I 'expanded' on the research activities to include some medical aspects that can be considered as part of the prior research in animation databases. I have been able to expand on the scope of research activities to include the medical aspects because of the excellent matching funds provided by my University and School of Engineering. The following activities were carried last year (some from the proposed tasks and some from the expanded tasks):

1. Integration of 3D motion capture with other medical sensor data.
2. Using deformable 3D models for animation and streaming,
3. Streaming 3D models and Quality of Service (QoS) in wireless networks.
4. Tamper proofing and watermarking 3D models and motions.

We carried out several experiments integrating 3D motion capture with other medical sensors such as EMG/EKG. We have been testing different algorithms that can classify and mine patterns in such 'integrated' medical data.

We have begun to study deformable models and their characteristics with a view to use them in animation and streaming such animations. Deformable models have different characteristics and representations compared to 3D meshes, and are inherently very useful for simulation and animations.

For tamper proofing and copy righting 3D models and motions, we identified that the main problem is formulating a cluster of data points. We developed approaches that will enable identification of data clusters. These data clusters can then carry watermarks either for tamper proofing or copyrighting.

Through these research activities, several graduate students were trained. 6 PhD students and 7 Masters students carried out research under various topics. 3 PhD students and 4 Masters student defended their theses last year.

The animation toolkit underwent several updates. We have sophisticated user interfaces and a decent database of 3D models and motions. The toolkit source code will be made public in Fall 2007.

Findings:

1. For tamper proofing and copy righting 3D models and motions, we identified that the main problem is formulating a cluster of data points. We developed approaches that will enable identification of data clusters. These data clusters can then carry watermarks either for tamper proofing or copyrighting.
2. For integrated medical data, we have come up with variations of 'Multi-factor analysis' (MFA) approach. This approach help us to classify the integrated medical data with reasonable accuracy and we are currently working on mining patterns in this database.
3. We extended our error concealment approach for 3D mesh streaming to provide more accurate reconstruction of the meshes under lossy network conditions. This error concealment approach is able to work with multiple 3D compression schemes such CPM (Compressed Progressive Meshes), PM (Progressive Meshes), and PFS (Progressive Forest Split).

Training and Development:

Through these research activities, several graduate students were trained. 3 PhD students and 4 Masters students defended their theses last year. 4 Phd students and 3 MS students are currently carrying out research under various topics.

Outreach Activities:

I gave presentations for Middle School students to encourage them take up Science and Engineering as their college majors. I also mentored 1 Senior high school student last summer and will be doing it for one another student this summer.

ACM's SIGMM (Special Interest Group on Multimedia) web site is being hosted from my lab. I am disseminating the project findings through this web site.

Journal Publications

Chuanjun Li, Latifur Khan and B. Prabhakaran, "Real-time Classification of Variable Length Multi-attribute Motion Data", Knowledge and Information Systems: An International Journal (KAIS), Springer, p. 163-1, vol. , (2006). Published,

Ming Li, Hua Zhu, Imrich Chlamtac, B. Prabhakaran, "End-to-end QoS Framework for Heterogeneous Wired-cum-Wireless Networks", ACM/Springer Wireless Networks (WINET), p. 439-450, vol. 12, No., (2006). Published,

Akanksha, Z. Huang, B. Prabhakaran, and C.R. Ruiz, "Animation Toolkit Based on Database Approach for Reusing Motions and Models", Multimedia Tools and Applications, Kluwer Academic Publishers, p. 293-328, vol. 32, No., (2007). Published,

Hui Li, Ming Li, and B. Prabhakaran, "Middleware for Streaming 3D Progressive Meshes over Lossy Networks", ACM Transactions on Multimedia Computing, Communications, and Applications (TOMCCAP), p. 282-317, vol. 2, No., (2006). Published,

Chuanjun Li, S. Q. Zheng and B. Prabhakaran, "Segmentation and Recognition of Multi-Attribute Motion Sequences", ACM Transactions on Multimedia Computing, Communications and Applications (ACM TOMCCAP), p. , vol. 3, No., (2007). Published,

Phani S Kotharu and B. Prabhakaran, "Partial Fuzzy Query Resolution for Animation Authoring", ACM Transactions on Multimedia Computing, Communications, and Applications (TOMCCAP), p. , vol. , (). Accepted,

Chuanjun Li, P. R. Kulkarni and B. Prabhakaran, "Motion Stream Segmentation and Recognition by Classification", International Journal of Multimedia Tools and Applications (MTAP), p. , vol. , (). Accepted,

Chuanjun Li and B. Prabhakaran, "Indexing of Motion Capture Data for Efficient and Fast Similarity Search", Journal of Computers (JCP), p. 35-42, vol. 1, No., (2006). Published,

Books or Other One-time Publications

Chuanjun Li, P. R. Kulkarni and B. Prabhakaran, "Motion Stream Segmentation and Recognition by Classification", (2006). Conference Proceedings, Published
 Collection: Proceedings of the 31st IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2006)
 Bibliography: IEEE Press

Chuanjun Li and B. Prabhakaran, "A Novel Indexing Approach for Efficient and Fast Similarity Search of Captured Motions", (2006). Conference Proceedings, Published
 Collection: Proceedings of the 10th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD 2006)
 Bibliography: April 2006

Gaurav N. Pradhan, Navzer Engineer, Mihai Nadin, Balakrishnan Prabhakaran, "Integration of Motion Capture and EMG data for Classifying the Human Motions", (2007). Workshop proceedings, Published
 Bibliography: Proceedings of International Workshop on "Ambient Intelligence, Media, and Sensing (AIMS) 2007, (held along with International Conference on Data Engineering (ICDE), April

Hui Li, Parag Agarwal, Balakrishnan Prabhakaran, "Data Hiding based Compression Mechanism for 3D Models", (2007). Conference Proceedings, Published
 Bibliography: IEEE Data Compression Conference 2007 (DCC 2007).

Sagar Naik and B. Prabhakaran, "Shear Invariant 3D Model Retrieval", (2007). Conference Proceedings, Published
 Bibliography: Proceedings of International Workshop on Vision Geometry XV

Gaurav N. Pradhan, Chuanjun Li, and Balakrishnan Prabhakaran, "Hierarchical Indexing Structure for 3D Human Motions", (2007). Conference Proceedings, Published
 Bibliography: Proceedings of International Conference on Multimedia Modeling Conference (MMM) 2007

Parag Agarwal, Balakrishnan Prabhakaran, "Tamper Proofing of 3D motion Data Streams", (2007). Conference Proceedings, Published
 Bibliography: Proceedings of 13th International Multimedia Modelling Conference 2007 (MMM 2007)

Parag Agarwal, Ketaki Adi, Balakrishnan Prabhakaran, "Robust Blind Watermarking Mechanism for Motion Data Streams", (2007). Conference Proceedings, Published
 Bibliography: Proceedings of ACM Multimedia and Security Workshop, Geneva, Switzerland, September 26-27,

Parag Agarwal, Ketaki Adi, Balakrishnan Prabhakaran, "SVD-Based Tamper Proofing Of Multi-Attribute Motion Data", (2006). Conference Proceedings, Published
 Bibliography: Proc. of The 12th International conference on Distributed Multimedia Systems (DMS), Grand Canyon,

Parag Agarwal, Balakrishnan Prabhakaran, Bhavani Thuraisingham, "Uncertainty: An Extra Layer of Security for Unauthorized Traffic based Web Services", (2006). Conference Proceedings, Published
 Bibliography: Proc. of The 12th International conference on Distributed Multimedia Systems (DMS), Grand Canyon

Puneet Maheshwari, Parag Agarwal, B. Prabhakaran, "Making SEMI-FRAGILE 3D Models Watermarking Robust Against Compression", (). Workshop proceedings, Accepted
 Bibliography: ACM Multimedia and Security 2007

Hui Li, Ming Li, B. Prabhakaran, "On Supporting High Quality 3D Geometry Multicasting over IEEE 802.11 Wireless LANs", (2007). Conference Proceedings, Accepted
 Bibliography: IEEE Broadnets 2007

Parag Agarwal, and B. Prabhakaran, "Robust Blind Watermarking

Mechanisms for 3D Point Sampled Geometry", (2007). Workshop proceedings, Accepted
Bibliography: 9th ACM Multimedia and Security Workshop 2007

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

1. For tamper proofing and copy righting 3D models and motions, we identified that the main problem is formulating a cluster of data points. We developed approaches that will enable identification of data clusters. These data clusters can then carry watermarks either for tamper proofing or copyrighting.
2. For integrated medical data, we have come up with variations of 'Multi-factor analysis' (MFA) approach. This approach help us to classify the integrated medical data with reasonable accuracy and we are currently working on mining patterns in this database.
3. We extended our error concealment approach for 3D mesh streaming to provide more accurate reconstruction of the meshes under lossy network conditions.

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Several graduate students were trained. I have graduated 3 PhD students so far: one is working as an Assistant Professor (California State University, Fresno), another as Post-doc (Brown University), and the 3rd as Research Engineer (Ask.com). Several Masters students also carried out research under various topics and have been well placed.

Currently, 4 PhD students and 3 MS students are working with me.

Contributions to Resources for Research and Education:

A large repository of 3D motions is now available to researchers as public data.

Contributions Beyond Science and Engineering:

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Unobligated funds: less than 20 percent of current funds

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Organizational Partners

Any Web/Internet Site

Any Product

Contributions: To Any Other Disciplines

Contributions: To Any Beyond Science and Engineering



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DEPARTMENT OF COMPUTER SCIENCE

July 25, 2007

National Science Foundation
Grant # 0237954

RE: Endorsement of the Work and Career Development Plan for National Science Foundation grant number 0237954 entitled "CAREER: Animation Databases" by PI: B. Prabhakaran.

Dear Sir/Madame,

This letter is to reaffirm the commitments of the Department of Computer Science, the University of Texas at Dallas, for the PI of the above proposal, Dr. Balakrishnan Prabhakaran.

The Department of Computer Science is providing the PI, Dr. Prabhakaran, with lab space for his research group and the use of computer equipment as well as secretarial support. The Department also has supported the PI to teach a course on Multimedia Database Management Systems in the Fall semester of 2006. He will possibly teach this course in Spring 2008 again. Through these courses the PI will be able to share and disseminate the findings of the project to graduate students.

Sincerely,

A handwritten signature in black ink, appearing to read 'D. T. Huynh', written in a cursive style.

Dr. D. T. Huynh
Professor and Computer Science Department Head

DTH/rd