

CURRICULUM VITAE

Personal Profile

Name : Nipun Kwatra
Email Address : nipun@cc.gatech.edu
Home Page : <http://www.cc.gatech.edu/~nipun>
Address : GVU Center, College of Computing; 85, 5th Street NW; Atlanta, GA 30332-0760, USA

Research Interests

Computer Graphics, Computer Animation, Computer Vision, Machine Learning. Physically based and Data driven Animation and Rendering.

Education

08/2004 - Present **M.S. in Computer Science**
Georgia Institute of Technology, Atlanta, GA
GPA 4.0/4.0

07/2000 - 05/2004 **B.Tech in Computer Science and Engineering**
Indian Institute of Technology, Delhi, India
GPA 8.93/10

Work Experience

2004 - Present **Georgia Institute of Technology** Atlanta, GA, USA
GRADUATE RESEARCH ASSISTANT – GVU Center, College of Computing
Developed a finger tracking application. Currently performing research in motion capture and physical simulation. Also working on developing a system for document tracking.

Summer 2003 **INRIA Rhône-Alpes** Grenoble, France
SUMMER INTERN – MOVI group
Analyzed the performance of various supervised and semi-supervised learning techniques on the problem of classifying incoming images according to their indoor or outdoor location, given a small set of training images taken at each location.

2003 - 2004 **Indian Institute of Technology, Delhi** New Delhi, India
SYSTEM ADMINISTRATOR – Computer Science & Engineering
Served as a voluntary system administrator of the departmental labs.

Summer 2002 **Indian Institute of Technology, Delhi** New Delhi, India
UNDERGRADUATE RESEARCH ASSISTANT – Computer Science & Engineering
Worked on developing a fast generic compiler for given language semantics.

Publications

UNDER REVIEW

N. Kwatra, C. Wojtan, I. Essa, G. Turk, P. J. Mucha and M. Carlson, "Water with Character(s): Fluid Simulation with Articulated Bodies," *Submitted to SIGGRAPH 2006*.

REFEREED PUBLICATIONS

V. Kwatra, I. Essa, A. Bobick, and N. Kwatra, "Texture Optimization for Example-based Synthesis," *Proc. ACM Transactions on Graphics, SIGGRAPH 2005*, 795-802, August 2005.

D. Mahajan, N. Kwatra, S. Jain, P. Kalra, and S. Banerjee, "A Framework for Activity Recognition and Detection of Unusual Activities," *Proc. Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP 2004)*, December 16-18, 2004.

TECHNICAL REPORTS

D. Mahajan, N. Kwatra, S. Jain, P. Kalra, and S. Banerjee, "A Framework for Activity Recognition and Detection of Unusual Activities," B.Tech Project Report, Department of Computer Science and Engineering, IIT Delhi, May 2004.

N. Kwatra, B. Triggs, "Where was this taken?" Semi-supervised kernel based learning for location recognition," Summer Internship Report, MOVI, INRIA Rhône-Alpes, Grenoble, France, July 2003.

Academic Awards

- Represented India in the **31st International Physics Olympiad** held in Leicester, England and won a **Bronze Medal** out of the 300 participants of 65 countries. The Indian Team stood an overall **3rd**.
- Won a **Gold Medal** for being among the top 5 out of 20,000 participants for the **National Physics Olympiad**. The Training of the top 30 was held in HBCSE, Mumbai.
- Selected among the top 30 students in India for the Training camp of the **32nd International Chemistry Olympiad**.
- Received the **INRIA-IIT** scholarship in the year 2003.
- Received the **Institute Merit Award** for being among the top 7% in the institute in Fall 2000.
- Received the **Institute Merit Award** for being among the top 3 in the Computer Science and Engineering Department successively in Fall 2001, Fall 2002, spring 2003, Fall 2003
- Secured **3rd** rank in Physica (physics competition), held in Tryst(All India Technical Festival, IIT Delhi).
- Secured **4th** rank in Techkriti'2002(All India Technical Festival, IIT Kanpur) in the working model contest, Endeavor.
- Secured **All India Rank 56** in the Joint Entrance Examination 2000 for admission to Indian Institutes Of Technology among the 150,000 aspirants.
- Secured **All India Rank 1** in the CET 2000 for entrance to Panjab Engineering College.

Projects

- **Water with Character(s): Fluid Simulation with Articulated Bodies**

Collaborators: Chris Wojtan, Prof. Irfan Essa, Prof. Greg Turk, Prof. Peter J. Mucha & Dr. Mark Carlson
We present an algorithm for creating realistic animations of characters that are interacting with fluids. Our approach combines dynamic simulation with data-driven (motion capture) and related kinematic motions to produce realistic animation in a fluid. The interaction of the articulated body with fluids is done by (a) incorporating joint constraints with rigid animation, and by (b) extending the Rigid Fluid method, which allows simulation of rigid bodies in a fluid, to deal with articulated chains. We introduce a constraint-based solver for coupling motion trajectories of articulated structures with fluid simulation. This solver takes as input the current state of the simulation and calculates the exact angular and linear accelerations of the connected bodies to incorporate motion trajectories into the simulation. These accelerations are used to estimate the forces and torques that are applied at each joint. These forces are used to conform the motion trajectories of the articulation data with the simulation of the fluid. We demonstrate results for animations such as swimming in water. The ability to have articulated bodies interact with fluids also allows us to generate simulations of simple water creatures that are driven by simple controllers.

- **Texture Optimization for Example-based Synthesis**

Collaborators: Dr. Vivek Kwatra, Prof. Irfan Essa & Prof. Aaron Bobick
We present a novel technique for texture synthesis using optimization. We define a Markov Random Field (MRF)-based similarity metric for measuring the quality of synthesized texture with respect to a given input sample. This allows us to formulate the synthesis problem as minimization of an energy function, which is optimized using an Expectation Maximization (EM)-like algorithm. In contrast to most example-based techniques that do region-growing, ours is a joint optimization approach that progressively refines the entire texture. Additionally, our approach is ideally suited to allow for controllable synthesis of textures. Specifically, we demonstrate controllability by animating image textures using flow fields. We allow for general two-dimensional flow fields that may dynamically change over time. Applications of this technique include dynamic texturing of fluid animations and texture-based flow visualization.
<http://www.cc.gatech.edu/~nipun/publications/TO/TO-final.pdf>

- **‘Where was this taken?’ – Semi-supervised kernel based learning for location recognition**

Advisor : Bill Triggs, Movi Project, INRIA Grenoble, France.
In this report we compare the performance of various supervised and semi-supervised learning techniques on the problem of classifying incoming images according to their indoor or outdoor location, given a small set of training images taken at each location. The results show that SVMs outperform all other inductive techniques. The semi-supervised transductive SVMs perform better than inductive SVMs for large enough data, but the performance falls when the training data is reduced to very low values
<http://www.cc.gatech.edu/~nipun/Projects/reportINRIA/report.pdf>

- **Activity Recognition**

Advisors: Prof. Subhashis Bannerjee & Prof. Prem Kalra (Deptt. of Computer Science & Engineering, IIT Delhi)

This project is related to high level monitoring of activities going on in a scene. We proposed a simple framework for activity recognition based on a model of multi-layered finite state machines, built on top of a low level image processing module for spatio-temporal detections and limited object identification. The finite state machine network learns, in an unsupervised mode, usual patterns of activities in a scene over long periods of time. Then, in the recognition phase, usual activities are accepted as normal and deviant activity patterns are flagged as abnormal.

We also extended this to recognize predefined activities and provided a programmable finite state machines for the same. We successfully demonstrated the technique for activities such as unidentified object detection and theft detection.

http://vglab.cse.iitd.ernet.in/research/research_group2/1/activmon/index.shtml

- **Augmented/Virtual Reality (Mini Project)**

Advisors : Prof. Subhashis Bannerjee & Prof. Prem Kalra

We presented a novel approach to augment destination environments with objects cut from source environments, rather than augmenting 3-d models, which allows us to create virtual environments augmented with real objects such that the user cannot tell the difference between the real world and the virtual augmentation of it.

The current work models the source objects as planes. A modified version of the ray tracing algorithm was developed which renders the destination environment using these planar objects and also the possible occluding planes in the destination environment. These planes in the destination environment were modeled using single view 3d reconstruction methods.

The present results are available on:

http://www.cc.gatech.edu/~nipun/aug_reality/AR.html

- **Independent Study On Quantum Computing.**

Advisor : Prof. Sandeep Sen, IITD.

In this Independent Study I went through the various basics and fundamentals of Quantum Computing. I studied various advanced algorithms like Quantum Fourier Transform, Grover Search Algorithm, Shor's Factorization Algorithm.

http://www.cc.gatech.edu/~nipun/Projects/quantum/quantum_computing.pdf

- **Recovering illumination distribution from shadows.**

Advisor : Prof. Subhashis Bannerjee

In this project I studied and implemented the estimation of illumination distribution of a real scene from radiance distribution inside shadows cast by an object in the scene.

- **Automated Navigation of a car using Computer Vision**

Advisor : Prof. Subhashis Bannerjee, IITD, India

The project involved automatically navigating a car through a 2-D maze(through a feedback mechanism) avoiding obstacles by viewing from an overhead camera(fixed). It involved developing a finite state machine for the control mechanism of the car and vision techniques like perspective correction, color segmentation, K-L transformations etc.

http://www.cc.gatech.edu/~nipun/toy_car/toycar.html

Awarded 4th position(Among 50 entries) in All India Inter-college Technical Fest held at Indian Institute of Technology, Kanpur in March'2002

- **Rapid Systems Programming**

Advisor : Prof. S. Arun Kumar, IITD, India

This project involved developing a *Generic System* that takes as input the structural operational semantics(SOS) of a programming language and a program string obeying the specified semantics and returns the evaluated string. It assumes some data-structures such as Environment and Store and some predefined hardware level functions like ADD, LESS THAN etc.

Course Projects

- **Photon Mapping**

Advisor: Prof. Greg Turk

Course: Advanced Image Synthesis

The aim of this project was to use the Photon Mapping technique proposed by Henrik Wann Jensen for global illumination. I successfully implemented the paper "Global Illumination using Photon Maps" by Henrik Wann Jensen. Results can be seen at:

<http://www.cc.gatech.edu/~nipun/Projects/photonMapping/pm.html>

- **Image Matting Using Variational Methods**

Advisor: Prof. Antony Yezzi

Course: PDEs and their application in Computer Vision and Image Processing

We used a variational approach to solve the image matting problem. We developed a novel energy function for describing the quality of a matte, foreground and background. The minimization of this energy function was done using a simple gradient descent method, which gave encouraging results.

Software and Hardware Skills and Experience

- *Language Skills* : C, C++, Perl, MATLAB, SML, JAVA, VRML, MIPS Assembly, Pascal, Prolog
- *OS Skills* : Linux, Unix, Win9x/NT, Sun Solaris, IRIX
- *Packages used/familiar* : OpenGL, OpenCV, Horatio, Gandalf
- *H/W tools used* : Xilinx, VHDL

Extra-Curricular Activities

- Won the best fresher award for Dance & Dramatics for the year 2000 in IIT Delhi.
- Won the Second Best Actor award in the inter-hostel Hindi Play competition held in 2002 in IIT Delhi.
- Coordinator (core-competitions) in Tryst(Technical Festival IIT-Delhi), 2004.(www.iitd.ernet.in/~tryst) which involved managing a team of approximately 200 people.
- Won 2nd prize in the inter-hostel swimming relay competition held in 2000 in IIT Delhi.
- Held the post of Representative of “Photographic and Audio Visual Development Society” of IIT Delhi for 2001-2002.

References

Prof. Irfan A. Essa (Advisor)

Associate Professor, College of Computing
Georgia Institute of Technology
irfan@cc.gatech.edu
+1 (404) 894-6856 Tel +1 (404) 894-0673 Fax

Prof. Greg Turk (Co-advisor)

Associate Professor, College of Computing
Georgia Institute of Technology
turk@cc.gatech.edu
+1 (404) 894-7508 Tel +1 (404) 894-0673 Fax

Prof. Peter J. Mucha (Co-advisor)

Assistant Professor, Applied Mathematics Program
Institute for Advanced Materials
The University of North Carolina at Chapel Hill
much@unc.edu
+1 (919) 843-2550 Tel +1 (919) 962-9345 Fax

Prof. Anthony J. Yezzi (Course Instructor)

Associate Professor, School of Electrical and Computer Engineering
Georgia Institute of Technology
ayezzi@ece.gatech.edu
+1 (404) 385-1017 Tel +1 (404) 894-4641 Fax