

Ning Hu

ADDR. : COMPUTER SCIENCE DEPARTMENT
CARNEGIE MELLON UNIVERSITY
5000 FORBES AVENUE
PITTSBURGH, PA 15213
PHONE : (O) 412-268-1557 (M) 412-401-8341
EMAIL : ninghu@cs.cmu.edu
WEB : <http://www.cs.cmu.edu/~ninghu>

RESEARCH INTERESTS

Multimedia (especially Music / Audio) Information Retrieval and Data Mining, Machine Learning, Audio Analysis and Computer Music

EDUCATION

- 2002 - Present **Carnegie Mellon University, Pittsburgh PA**
- Ph.D. Student, Computer Science
Advisor: [Roger B. Dannenberg](#)
Granted M.S. in Computer Science (May 2003)
- 2000 - 2002 **School of Computer Science, Carnegie Mellon University**
- Master, Entertainment Technology
- 1996 – 2000 **Tsinghua University, Beijing, China**
- B.E., Computer Science and Technology
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RESEARCH EXPERIENCE

- 2000 – Present **[Computer Music Group](#), Carnegie Mellon University**
- *Music Information Retrieval (MIR)*
 - Investigated and designed the retrieval techniques for "Query-by-Humming" IR system and algorithms (Dynamic Programming and Hidden Markov Model) for melodic similarity comparison
 - Collaborated to design interactive interfaces for future, intelligent music browsers and databases
 - *Automatic Audio Analysis*
 - Researched the polyphonic structural analysis of music by using adaptive Dynamic Programming on audio (spectrum, chroma) and / or symbolic (MIDI) representations
 - Designed and implemented Hidden Markov Model for precise audio alignment
 - *Computer Music*
 - Designed and developed a high-quality piano synthesizer and a most popular windows IDE for Nyquist (a sound synthesis & composition language)
- 2001 – 2002 **Entertainment Technology Center, Carnegie Mellon University**

- [Training for Physical Tasks in Virtual Environments: Tai Chi](#)
 - Collaborated to develop a wireless virtual reality system that combines full-body real-time motion capture and wireless head-mounted display. A prototype full-body Tai Chi training application was also built with it
 - Solely responsible for Researching and implementing real-time filters (damping filter, low pass filter, Kalman filter, etc.) for noisy motion capture data, and analyzing Tai Chi experiment data through various statistical approaches

1999 – 2000

Human Interaction & Media Integration Lab, Tsinghua University

- *MPEG-1, MPEG-2 and MPEG-4 standards research and applications*
 - Independently implemented a simple yet working MPEG-1 video surveillance system in Visual C++ as the diploma project
 - Completed the thesis about MPEG standards research and algorithm improvements on video data compression and object tracking

WORK EXPERIENCE

2002

Summer Research Intern

Language Technology Institute, CMU

- Took part in the development of [JAVELIN](#), an open-domain question answering system, and prepared it for the TREC 2002 question-answering track.
- Solely responsible for the development and improvement on one of the main components Request Filler, which identifies and scores answers from a set of potentially relevant documents. Major contributions include component expansion for new answer types, feature vectors evaluation and selection, decision tree classifier (c4.5) training and improvement, new classifier (K-Nearest-Neighbor implementing KD-trees) development, data and result analysis, module maintenance, etc.

1999 - 2000

Part-time programmer

www.Chinaren.com

- Independently developed a multi-player online game engine in JAVA
- Took part in the development of several JAVA online games

PROJECT EXPERIENCE

Spring, 2003

Graduate Database System course project

Carnegie Mellon University

- *Ning Hu and Minglong Shao*, "[Kalman-Tree: an Index Structure on Spatio-Temporal Data](#)"
- The project proposes a modified R-tree indexing structure (KR-tree) targeting the future location estimation problem in spatio-temporal databases, by integrating the useful estimator Kalman filter.

Fall, 2002

Grad. Computer Architecture course project

Carnegie Mellon University

- *Ning Hu and Vahe Poladian*, "[Characterizing and Enhancing the Performance of Sound Synthesis Applications on Pentium III](#)"
- The final project report was approved "publishable" by the course instructor Professor Seth Goldstein

Spring, 2002

Computer Animation course project

Carnegie Mellon University

- *Ning Hu, Philo Chua, Kevin Auyoung*, "[Musically Interactive Rendered Animation \(MIRA\)](#)"
- Built an animated figure that dances on stage with the rhythm / music using an existing set of motion capture data. Main techniques involved are Motion Capture, Motion Blending, Beat Tracking, Non-Photorealistic

PUBLICATIONS

- The Musart Testbed for Query-By-Humming Evaluation
Dannenberg, Birmingham, Tzanetakis, Meek, Ning Hu, Pardo, Proc. 4th International Conference on Music Information Retrieval (ISMIR), 2003
Also to appear in Computer Music Journal, 2004
- Polyphonic Audio Matching and Alignment for Music Retrieval
Ning Hu, Roger B. Dannenberg and George Tzanetakis, Proc. IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA), 2003
- Polyphonic Audio Matching for Score Following and Intelligent Audio Editors
Roger B. Dannenberg and Ning Hu, Proc. Int. Computer Music Conference (ICMC), 2003
- Toward an Intelligent Editor for Jazz Music
George Tzanetakis, Ning Hu and Roger B. Dannenberg, Proc. IEEE Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS), 2003
- Training for Physical Tasks in Virtual Environments: Tai Chi
Chua, Crivella, Daly, Ning Hu, Schaaf, Ventura, Camill, Hodgins, Pausch, Proc. IEEE Virtual Reality (VR), 2003
- The JAVELIN Question-Answering System at TREC 2002
Nyberg, Mitamura, Carbonell, Callan, Collins-Thompson, Czuba, Duggan, Hiyakumoto, Ning Hu, Huang, Ko, Lita, Murtagh, Pedro and Svoboda, Proc. TREC 11, Nov 2002
- Pattern Discovery Techniques for Music Audio
Roger B. Dannenberg and Ning Hu, Proc. 3rd International Conference on Music Information Retrieval (ISMIR), 2002
- A Probabilistic Model of Melodic Similarity
Ning Hu, Roger B. Dannenberg and Ann L. Lewis, Proc. International Computer Music Conference (ICMC), 2002
- Discovering Musical Structure in Audio Recordings
Roger B. Dannenberg and Ning Hu, Proc. 2nd Int. Conference in Music & Artificial Intelligence (ICMAI), 2002.
Also appeared in the book Lecture Notes in Computer Science, Volume 2445
- A Comparison of Melodic Database Retrieval Techniques Using Sung Queries
Ning Hu and Roger B. Dannenberg, Proc. Second ACM / IEEE-CS Joint Conference on Digital Libraries (JCDL), 2002

TECHNICAL SKILLS

- **Languages:** C / C++, Java, Pascal, Python, Perl, LISP, SQL, 80x86 / Alpha Assembly
- **OS:** Windows 9x / NT / 2000 / XP, Linux / Unix, DOS
- **IDE:** GNU GCC, Microsoft Visual Studio (Visual C++, Visual J++, Visual Basic), Matlab, Delphi, Borland JBuilder
- **API / SDK:** DirectX, OpenGL, WinSock / Berkeley Socket API, MFC/Win32 API, Windows multimedia system SDK