

# Ching-Yung Lin

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## Education

<b>Ph.D.</b>	Electrical Engineering	Columbia University, New York, NY	2000
	Specialization: Multimedia Analysis and Security (GPA:4.0/4.0)		
<b>M.S.</b>	Electrical Engineering	National Taiwan University, Taipei, Taiwan	1993
	Specialization: Image and Video Processing (Highest GPA in Communications and Signal Processing)		
<b>B.S.</b>	Electrical Engineering	National Taiwan University, Taipei, Taiwan	1991
	Specialization: Communications and Signal Processing		

## Work Experience

<b><i>Research Staff Member and Social &amp; Cognitive Network Science Research Lead</i></b>	IBM T. J. Watson Research Center, Hawthorne, NY	10/2009 to present
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- IBM Lead of Social and Cognitive Network Academic Research Center (2009 – 2014 or 2019)
- (June 2010) Selected as one of the five “IBM researchers most likely to have the greatest scientific impact for IBM and the world”. [IBM Exploratory Science Career Review].
- Principle Investigator of 6 to 7 funded SmallBlue research projects in 2011 (2011 funding: \$3 million to \$3.5 million).
- (2010 – 2011) Leading fundamental scientific research project including 18 PIs in 14 institutes for “Value of Network Interactions” (IBM, CUNY, Notre Dame U., NYU, Carnegie Mellon U., UC Santa Barbara, U. Minnesota, RPI, MIT, U Michigan, BBN, Stanford, USC, Northeastern U., and Penn State U.)
- (2009 – 2010) Led fundamental scientific research project including 18 PIs in 13 institutes for “Networks in Organization”. ( IBM, CUNY, MIT, Northeastern U, RPI, Notre Dame, Indiana U., U. Minnesota, Carnegie Mellon U., NYU, Northwestern U, Harvard, and U of Michigan)
- Leading IBM fundamental research of network science, focusing on: (1) scientific challenge of large-scale and real-time network processing system; (2) economic value of networks; (3) multi-channel relationships and collective behavior of people; and (4) cognitive (brain) signal processing. The goals are to make real large-scale system for computational social science researches and to understand people behavior from cognitive level to societal level, based on signal processing and data mining.
- Leading IBM applied research of network science, focusing on: (1) collaborations, including expertise mining & search, social network visual analytics, shortest social paths, and personalized recommenders & search; (2) security, including anomaly detection, privacy research of law level, data mining level and cryptographic level, and authentication & data leakage prevention; (3) commerce, including social selling and marketing; and (4) smarter planet, including sensor network data processing of New York (bus transportation) and Boston (traffic and air pollution sensors).
- Leading more than 20 researchers for IBM SmallBlue Projects, including SmallBlue Enterprise Edition ( for customer selling via IBM Atlas brand and IP licensing), SmallBlue Internet Edition (collaborating with NIH and Shell), SmallBlue Security Edition (DARPA ADAMS, IBM Cybersecurity Center Offering), and SmallBlue Commerce Edition (IBM Commerce Industry Solution Offering).

<b>Research Staff Member and Project Lead</b>	IBM T. J. Watson Research Center, Hawthorne, NY Dept. of Stream Processing / Dept. of Collaboration Technologies	01/2006 to present
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- Invented and created the Small Blue system in early 2006. I invented SmallBlue for (1) solving the enterprise expertise search for collaboration, (2) quantifying social capital of individuals and best social paths to reach people, (3) analyzing social positions of any group of people in enterprise, (4) providing personalized content recommendation and search based on ranking of content interests and collective behavior of multi-degree personal social network. This was an era before the take-off of social media, and a novel solution to address one of the biggest challenge of utilizing observable data (i.e. novel social sensors) to understand people (see appendix).
- SmallBlue was transferred to product-level asset by IBM Global Business Services (2007) and IBM Lotus Software, called IBM Atlas (2008).
- Led and guided a multi-division global team of more than 30 researchers and engineers for the Research and Development of Small Blue. Team members include: researchers in New York, Boston, and Beijing; developers in Shanghai and Moscow; system maintenance & deployment in Mumbai, help desk in Tampa; and user interface redesign in London.
- IBM Global Business Service estimation of internal financial contribution to IBM in 2009: \$31 million.
- IBM Atlas was sold and deployed to AT&T, Pepsi Co., United Nations, Ernst & Young, Coca Cola, the World Bank, Royal Bank of Scotland (RBS), Federal Aviation Association (FAA).
- Research being featured in 120+ media articles, including BusinessWeek, BBN, MIT Review, Forbes, etc.
- Reported 4 times by BusinessWeek:
  - Jan. 17, 2008, “International Isn’t Just IBM’s First Name,” SmallBlue was discussed as the concluding paragraphs – “IBM introduced a version of Small Blue called IBM Atlas for sale to customers. The company is positioning itself as a helping hand to other corporations who are taking similar paths to globalization.....”
  - May 22, 2008: “Big Blue Embraces Social Media,” it shows “Atlas culls information from e-mail and instant chat, and helps people map and visualize their networks of contacts. .... Atlas (helps) Lotus Connections being the fastest-growing software product in IBM history.”
  - April 8, 2009: BusinessWeek’s Top Story of Week, an article featuring one of SmallBlue’s researches: “Putting a Price on Social Connection”.
  - May 21, 2009: BusinessWeek Cover Story, “One team at IBM Research, studying anonymous data of Big Blue’s consultants, concluded that employees who forged tighter e-mail connections with their boss brought in on average \$588 more in monthly revenue.,,.,”
- One+ Magazine, Jan 2009. Special article of “Social Currency” , which features my research career towards SmallBlue and with intensive photos.
- Research statement in 2005 of making signal processing and data mining to make an entire shift of paradigm on Computational methods for Social Science was cited by “History of Social Science” in Wikipedia in 2009, for the statement of progress of social science.

<b>Research Staff Member</b>	IBM T. J. Watson Research Center, Hawthorne, NY Dept. of Stream Processing	07/2004 to 12/2005
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- Led projects on large-scale real-time video and multimodality semantic understanding, filtering and sensor networks for NSA.
- Research on distributed signal processing, machine learning based on noisy data, and multimodality human behavior modeling.

<b>Research Staff Member</b>	IBM T. J. Watson Research Center, Hawthorne, NY Dept. of Intelligent Business Information	10/2000 to 06/2004
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- Invented the first large-scale video tagging system and led 111 researchers in 23 worldwide research institutes for a one-year video collaborative annotation project in 2003. This was one of the few critical works that set the future direction of large-scale data-driven video analytics research pursued

by thousands of researchers today. It also successfully jump started the TRECVID video retrieval forum that has become extremely popular and attracted participation by hundreds of groups so far.

- Research on video semantic indexing, video semantic concept detection, multimodality understanding and intelligence analysis. A core founder of the IBM Marvel project in 2001-2004.
- Developed surveillance system based on images, videos and environmental information.
- Established standard-compliant multimedia personalization, summarization, editing and transcoding systems.
- Participated in the development of MPEG-7 and MPEG-21 standards and applications.

<b><i>Adjunct Professor</i></b>	Department of Electrical Engineering, Columbia University, New York, NY	9/2010 to present
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- Teaching courses: *Network Science* (Fall 2010)
- Advising students on network science research projects.

<b><i>Adjunct Associate Professor</i></b>	Department of Electrical Engineering, Columbia University, New York, NY	1/2005 to 8/2007
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- Teaching courses: *Multimedia Security Systems* (Spring 2005, Summer 2005, Spring 2006, Summer 2007)
- Advising students on smart video semantic sensor, expertise search, and personalized recommendation projects.

<b><i>Affiliate Associate Professor</i></b>	Department of Electrical Engineering, University of Washington, Seattle, WA	11/2005 to 10/2009
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- Co-advising Ph.D. students (with Prof. Ming-Ting Sun) on data mining and signal processing for human and social network analysis, and multimodality healthcare applications, in the Information Processing Lab.

<b><i>Affiliate Assistant Professor</i></b>	Department of Electrical Engineering, University of Washington, Seattle, WA	11/2003 to 10/2005
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- Co-advising Ph.D. students (with Prof. Ming-Ting Sun) on data mining and signal processing for human and social network analysis, and multimodality healthcare applications, in the Information Processing Lab.

<b><i>Research Assistant</i></b>	Columbia University, New York, NY	1/1997 - 9/2000
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- Designed and implemented the first successful semi-fragile content authentication system, which distinguishes standard-compliant compressions from malicious manipulation.
- Modeled signal variation and pioneered a public watermarking technique for digital image print-and-scan process.
- Established theorems of the theoretical information-hiding capacity of media data.

<b><i>Teaching Assistant</i></b>	Columbia University, New York, NY	9/1996 – 12/1999
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- TA for the Advanced Signal Processing course.
- Developed an interactive multimedia system for Columbia Video Network, used in the Image/Video Processing course.

<b>Summer Intern</b>	NEC Research Institute, Princeton, NJ	5/1999 - 8/1999
<ul style="list-style-type: none"> <li>• Designed and implemented public watermarking methods to survive geometric distortion.</li> <li>• Modeled signal variation in DVD/VHS video transcoding process.</li> </ul>		
<b>Instructor</b>	National Taiwan University, Taipei, Taiwan	8/1995 - 7/1996
<ul style="list-style-type: none"> <li>• Instructed graduate students on the computer network programming and analysis lab course.</li> <li>• Assisted to establish the computer network lab in National Taiwan University.</li> <li>• Assisted to the management issues of the Telecommunication Center in National Taiwan University.</li> </ul>		
<b>R &amp; D Engineer</b>	EeRise Co., Taipei, Taiwan	12/1995 - 7/1996
<ul style="list-style-type: none"> <li>• Designed a computer vision system for detecting sub-pixel object positions to correct monitor misconvergence.</li> </ul>		
<b>Air Force 2<sup>nd</sup> Lieutenant</b>	Air Force, Chiayi Airport, Taiwan	7/1993 - 5/1995
<ul style="list-style-type: none"> <li>• Maintained military ground-to-ground and ground-to-air communication systems including wireless base stations, handsets, control tower and radar station.</li> </ul>		
<b>Research Assistant</b>	National Taiwan University, Taipei, Taiwan	8/1991-6/1993
<ul style="list-style-type: none"> <li>• Developed algorithms for image/video coding, shape recognition, 2D filter design, and wavelet analysis.</li> <li>• Designed systems for detection and segmentation of infrared targets; Benchmarking of phase array radar detectors.</li> </ul>		

## Selected Awards

- IBM Exploratory Science Career Review, Nov. 2010.  
-- To discover and support "researchers most likely to have the greatest scientific impact for IBM and the world. Select no more than 5 researchers per year among IBM's worldwide researchers. This review program starts in 2010.
- IEEE Circuits and Systems Society Outstanding Young Author Award, 2003.  
-- To honor an especially meritorious paper published in any one of the IEEE CAS Society's eight Transactions during the calendar years of 2001 and 2002 whose author at the date of submission is less than 30 years of age. The award is based on general quality, originality, contributions, subject matter and timeliness.
- BusinessWeek Magazine – Top Story of the Week, April 10, 2009.
- IBM Research Division Award, 2005 and 2011 (for outstanding contribution to scientific impact or financial earning for IBM Corporation).
- IBM Invention Achievement Awards, 2001, 2003, 2007 and 2010.
- Best Performance in National Institute of Standards and Technology (NIST) TREC Video Semantic Concept Detection Benchmarking, 2002, 2003 & 2004.
- Best Performance in National Institute of Standards and Technology (NIST) TREC Video Retrieval, 2001, 2002. (2<sup>nd</sup> place: 2003)
- IEEE Circuits and Systems Society Service Award, 2006.
- Acer Best EECS Master Thesis Award in Taiwan (Lung-Terng Gold Award), 1993.

- Outstanding Paper Award, Conf. on Computer Vision, Graphics and Image Processing, 1993.

## Highly Cited Publications (h-index: 32):

1. Ching-Yung Lin, Min Wu, Jeffery Bloom, Ingemar Cox, Matt Miller, and, Yui Man Lui, "**Rotation, Scale, and Translation Resilient Watermarking for Images**," *IEEE Trans. on Image Processing*, 2001. (Cited by 526)
2. Ching-Yung Lin and Shih-Fu Chang, "**A Robust Image Authentication Method Distinguishing JPEG Compression from Malicious Manipulation**," *IEEE Trans. on Circuits and Systems for Video Technology*, Feb. 2001. (Cited by 332)
3. Ching-Yung Lin and Shih-Fu Chang, "**Semi-Fragile Watermarking for Authenticating JPEG Visual Content**," *SPIE Security and Watermarking of Multimedia Contents II*, EI '00, San Jose, CA, Jan. 2000 (Cited by 234)
4. Ching-Yung Lin and Shih-Fu Chang, "**A Robust Image Authentication Method Surviving JPEG Lossy Compression**," *SPIE Storage and Retrieval of Image/Video Database*, EI '98, San Jose, Jan. 1998. (Cited by 125)
5. A. Amir, W. Hsu, G. Iyengar, Ching-Yung Lin, M. Naphade, A. Natsev, C. Neti, H. J. Nock, J. R. Smith, B. L. Tseng, Y. Wu, D. Zhang, "**IBM Research TRECVID-2003 System**," *Proc. NIST Text Retrieval Conf. (TREC)*, Gaithersburg, MD, November, 2003. (Cited by 118)
6. Belle L. Tseng, Ching-Yung Lin and John R. Smith, "**Using MPEG-7 and MPEG-21 for Personalizing Video**," *IEEE Multimedia Magazine*, Jan.-Mar., 2004. (Cited by 108)
7. Bill Adams, Giri Iyengar, Ching-Yung Lin, Milind Naphade, Chalapathy Neti, Herriet Nock and John R. Smith, "**Semantic Indexing of Multimedia Content Using Visual, Audio and Text Cues**," *EURASIP Journal on Applied Signal Processing*, 2003 (Cited by 98)
8. Ching-Yung Lin, Belle L. Tseng and John R. Smith, "**Video Collaborative Annotation Forum: Establishing Ground-Truth Labels on Large Multimedia Datasets**," *Proc. of NIST Text Retrieval Conf. (TREC)*, Gaithersburg, MD, November 2003. (Cited by 91)
9. Ching-Yung Lin and Shih-Fu Chang, "**Issues and Solutions for Authenticating MPEG Video**," *SPIE Security and Watermarking of Multimedia Contents*, EI '99, San Jose, CA, Jan. 1999. (Cited by 86)
10. Ching-Yung Lin and Shih-Fu Chang, "**Generating Robust Digital Signature for Image/Video Authentication**," *Multimedia and Security Workshop at ACM Multimedia 98*, Bristol, UK, Sept. 1998. (Cited by 77)
11. Ching-Yung Lin, "**Issues on Multimedia Authentication**," in *Multimedia Security: steganography and digital watermarking techniques for protection of intellectual property*, IGP, March 2004. (Cited by 57)
12. Ching-Yung Lin, Belle L. Tseng and John R. Smith, "**VideoAnnEx: IBM MPEG-7 Annotation Tool for Multimedia Indexing and Concept Learning**," *IEEE Intl. Conf. on Multimedia & Expo*, Baltimore, July 2003. (Cited by 57)
13. Xiaodan Song, Belle L. Tseng, Ching-Yung Lin and Ming-Ting Sun, "**Personalized Recommendation Driven by Information Flow**," *ACM SIGIR Conference*, Seattle, WA, August 2006. (Cited by 57)
14. Ching-Yung Lin and Shih-Fu Chang, "**Distortion Modeling and Invariant Extraction for Digital Image Print-and-Scan Process**," *Intl. Symp. on Multimedia Information Processing (ISMIP)*, Taipei, Taiwan, Dec. 1999. (Cited by 55)

15. Jeffrey Bloom, Ingemar J. Cox, Matthew Miller, Min Wu, Ching-Yung Lin and Yui Man Lui, "**Rotation, Scale, and Translation Resilient Public Watermarking for Images using a Log-Polar Fourier Transform**", *United States Patent: US 6,282,300*. August 28, 2001. (Cited by 54)
16. B. Adams, A. Amir, C. Dorai, S. Ghosal, G. Iyengar, A. Jaimes, C. Lang, Ching-Yung Lin, A. Natsev, C. neti, H. J. Nock, H. Permuter, R. Singh, J. R. Smith, S. Srinivasan, B. L. Tseng, AT Varadaraju and D. Zhang, "**IBM Research TREC-2002 Video Retrieval System**," *NIST TREC-11 Text Retrieval Conference*, Gaithersburg, MD, Nov. 2002. (Cited by 52)
17. Shih-Fu Chang and Ching-Yung Lin, "**Method and Apparatus for Image Authentication**," *United States Patent: US 6,532,541*. March 31, 2003. (Cited by 51)
18. Belle L. Tseng, Ching-Yung Lin and John R. Smith, "**Video Summarization and Personalization for Pervasive Mobile Devices**," *SPIE EI 2002 – Storage and Retrieval for Media Databases*, San Jose, Jan. 2002. (Cited by 51)
19. Wenjun Zheng, Heather Yu and Ching-Yung Lin, "**Multimedia Security Technologies for Digital Rights Management**," *Elsevier*, June 2006. (Cited by 51)
20. Tian-Tsong Ng, Shih-Fu Chang, Ching-Yung Lin and Qibin Sun, "**Passive-Blind Image Forensics**" in *Multimedia Security Technologies for Digital Rights Management*, Elsevier, April 2006. (Cited by 46)
21. Winston Hsu, Shih-Fu Chang, Chih-Wei Huang, Lyndon Kennedy, Ching-Yung Lin and Giri Iyengar, "**Discovery and Fusion of Salient Multi-modal Features towards news Story Segmentation**," *SPIE EI 2004 – Storage and Retrieval for Media Databases*, San Jose, January 2004. (Cited by 43)
22. Kate Ehrlich, Ching-Yung Lin and Vicky Griffiths-Fisher, "**Searching for experts in the enterprise: Combining text and social network analysis**," *ACM Group Conference*, Sanibel Island, FL, November 2007. (Cited by 43)
23. Ching-Yung Lin, "**Watermarking and Digital Signature Techniques for Multimedia Authentication and Copyright Protection**," *Ph.D. Thesis*, Columbia University, Dec. 2000. (Cited by 41)
24. John R. Smith, Sankar Basu, Ching-Yung Lin, Milind Naphade and Belle L. Tseng, "**Integrating Features, Models, and Semantics for Content-Based Indexing and Retrieval**," *NSF Workshop in Multimedia Content-Based Indexing and Retrieval*, Sept. 2001. (Cited by 40)
25. Ching-Yung Lin and Shih-Fu Chang, "**SARI: Self-Authentication-and-Recovery Image Watermarking System**," *ACM Multimedia 2001*, Ottawa, Canada, Sept. 2001. (Cited by 40)
26. Belle L. Tseng, Ching-Yung Lin, Milind Naphade, Apostol Natsev and John R. Smith, "**Normalized Classifier Fusion for Semantic Visual Concept Detection**," *IEEE Intl. Conf. on Image Processing*, Barcelona, September 2003. (Cited by 37)
27. Ching-Yung Lin and Shih-Fu Chang, "**Zero-Error Information Hiding Capacity for Digital Images**," *IEEE Intl. Conf. On Image Processing*, Greece, Oct. 2001. (Cited by 36)
28. Xiaodan Song, Belle L. Tseng, Ching-Yung Lin and Ming-Ting Sun, "**ExpertiseNet: Relational and Evolutionary Expert Modeling**," *Intl. Conf. on User Modeling*, Edinburgh, UK, July 2005. (Cited by 35)
29. Milind Naphade, Sankar Basu, John R. Smith, Ching-Yung Lin, and Belle L. Tseng, "**Modeling Semantic Concepts to Support Query by Keywords in Video**," *IEEE Intl. Conf. on Image Processing*, Rochester, NY Sep. 2002. (Cited by 34)
30. Xiaodan Song, Ching-Yung Lin, Belle L. Tseng and Ming-Ting Sun, "**Modeling and Predicting Personal Information Dissemination Behavior**," *ACM SIGKDD Intl. Conf. on Knowledge Discovery and Data Mining*, Chicago, August 2005. (Cited by 33)
31. Belle L. Tseng, Ching-Yung Lin, and John R. Smith, "**Real-Time Video Surveillance for Traffic Monitoring System using Virtual Line Analysis**," *IEEE Intl. Conf. on Multimedia & Expo*, Lausanne, Switzerland, Aug. 2002 (Cited by 32)

- 32 . Winston Hsu, L. Kennedy, C.-W. Huang, S.-F. Chang, Ching-Yung Lin and G. Iyengar, “**News Video Story Segmentation using Fusion of Multi-Level Multi-Modal Features in TRECVID**,” *IEEE Intl. Conf. on Acoustics, Speech, and Signal Processing*, Montreal, May 2004. (Cited by 32)

## Selected Recent Professional Activities

- **Editorships:**

- **The Editor of Interactive Magazines (EIM): Communications Magazine, Network Magazine, and Wireless Magazine**, IEEE Communications Society (ComSoc), 2004-2007.

-- The Interactive Magazines Editorial Board is responsible for the multimedia enhancements, as well as the On-line interactive magazines only articles. Members of the Interactive Magazines Editorial Board are appointed by the Editor of the Interactive Magazines (EIM). The EIM is a one of the eleven members at the ComSoc Magazines Board, with other ten Editor-in-Chiefs of ComSoc Magazines.

- **Associate Editor**, IEEE Trans. on Multimedia, 2004 – 2007.
- **Member of Editorial Board**, Journal of Visual Communication and Image Representation, 2005 – 2010.
- **Guest Editor**, Proceedings of the IEEE, *Special Issue on Enabling Security Technologies for Digital Rights Management*, June 2004.
- **Guest Editor**, EURASIP Journal on Applied Signal Processing, *Special Issue on Visual Sensor Network*, Sept. 2006.
- **Guest Editor**, IEEE Trans. on Multimedia, *Special Issue on Communities and Media Computing*, April 2009.
- **Steering Committee**, *IEEE Trans. on Multimedia*, 2010-2011.

- **International Project and Organization Lead:**

- **Chair - Video Collaborative Annotation**, supported by NIST, Library of Congress, and 23 other worldwide institutes, including 111 researchers, Feb 2003 – Nov 2003.
  - I initiated and led this first large-scale video annotation project. I also developed the first distributed collaborative video annotation system being used in this project. One hundred and eleven researchers participated. The goal was to establish semantic ontology and associate semantic ground-truth labels to a large video dataset of 63 GB. The objective was to establish a common large-scale database to foster the research of video understanding and semantic retrieval.
- **Chair**, *IEEE Circuits and Systems Society Multimedia System and Application Technical Committee*, 2010-2011; **Secretary** 2008-2009.

- **International Conference Organization:**

- **General Chair**, *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Cancun, Mexico, June 2009.
  - ICME is the flagship multimedia conference in IEEE, jointly sponsored by IEEE Signal Processing Society, Communication Society, Circuits and Systems Society and Computer Society
- **Technical Program Chair - Multimedia**, *Wireless and Optical Communications Conference*, Shanghai, October 2006.

- **Founding Steering Committee Chair**, *ACM SIG Health Informatics International Health Informatics Symposium*, 2010-2012. (Established a new SIG in ACM and it's flagship conference. )
- **Founding Steering Committee and Plenary Chair**, *IEEE Emerging Signal Processing Applications Conference (ESPA)*, Las Vegas, NV, Jan. 2012. (ESPA will be one of the 3 core conferences of IEEE SP society, in conjunction with ICASSP and ICIP, which are considered too academic. ESPA will focus on industry.)
- **Steering Committee**, *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, 2005 – 2006, 2009 - 2011; **Chair**, June-Oct 2009.
- **Student Paper Award Chair - Multimedia**, *IEEE Intl. Conf. on Acoustic, Speech and Signal Processing (ICASSP)*, Honolulu, Hawaii, April 2007.
- **Student Paper Award Chair**, *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Toronto, July 2006.
- **Area Chair**, *Multimedia Content Analysis, IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Toronto, July 2006.
- **Area Chair**, *Multimedia Understanding and Recognition, IEEE Intl. Symposium on Circuits and Systems (ISCAS)*, Kos, Greece, May 2006.
- **Registration Chair** – *IEEE Intl. Workshop on Multimedia Signal Processing (MMSP)*, Shanghai, Oct 2005.
- **Best Open-Source Software Chair** – *ACM Multimedia (ACMMM)*, Singapore, Nov 2005.
- **Student Paper Award Advisory Board** – *IEEE Intl. Conf. on Image Processing (ICIP)*, Genova, Sep 2005.
- **Area Chair**, *Multimedia Understanding and Recognition, IEEE Intl. Symposium on Circuits and Systems (ISCAS)*, Vancouver, May 2004.
- **Student Paper Award Chair** – *IEEE Intl. Conf. on Image Processing (ICIP)*, Singapore, Oct 2004.
- **Publicity Chair** – *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Taipei, July 2004.
- **Technical Program Chair**, *IEEE Intl. Conf. on Information Technology: Research and Education (ITRE)*, Newark, August 2003.
- **Chair**, *Watson International Workshop on Multimedia*, Yorktown Heights, June 2003.
- **Publicity Chair** – *IEEE Pacific-Rim Conference on Multimedia (PCM)*, Beijing, Dec 2001.
  
- **Keynote Speaker:**
  - **“What’s a Friend Worth? Knowing Your Social Capital,”** *Web 2.0 Expo*, New York Javits (Convention) Center, November 2009.
  - **“Machine Learning and Mining from Multimodality Streams,”** *IEEE Pacific-Rim Symposium on Image and Video Technology (PSIVT)*, Hsinchu, Taiwan, December 2006.
  
- **Plenary Speaker:**
  - **“Mine Your Business – Value and Impact of Implicit Social Networks,”** *United States InfoSec Research Council (sponsored by 22 U.S. government departments and institutes)*, Arlington, VA, May 2010.
  - **“Mine Your Business – Value and Impact of Implicit Social Networks,”** *United States Finance Roundtable*, July 2010.

- **“Multimedia Security Systems,”** *Biometric for National Security and Defense Summit*, Arlington, VA, Feb. 2008.
- **“Collective Intelligence and Complex Network Analysis,”** *National Digital Archive Workshop*, Taipei, Taiwan, December 2008.
- **“Large-Scale Video Surveillance System and Multi-Dimensional Social network Analysis,”** *Emerging Digital Media Technologies Workshop*, Hsinchu, Taiwan, December 2008.
- **“Collective Intelligence and Complex Network Analysis,”** *the 125<sup>th</sup> Eastern Forum of Science and Technology*, Shanghai, China, December 2008.
- **“Computational Economic Impact of Social networks,”** *National Digital Archive Workshop*, Taipei, Taiwan, May 2009.
- **“Emerging Network Science,”** *National Digital Archive Workshop*, Taipei, Taiwan, November 2009.
  
- **Panelist:**
  - **“Markovian Information Propagation Behavior Modeling in Dynamic Probabilistic Social Networks,”** *19<sup>th</sup> Behavior Representation in Modeling & Simulation Conference*, Charleston, SC, March 2010.
  - **“Value and Culture Variety of Social Networks,”** *ACM Workshop on Connected Media*, December 2010.
  - **“Social Media,”** *National Science Foundation*, 2010.
  
- **Conference Tutorial Lecturer:**
  - **“Multimedia Security Technologies for Digital Rights Management,”** *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Beijing, China, July 2007,
  - **“Emerging Multimedia Understanding Technologies,”** *IEEE Intl. Workshop on Multimedia Signal Processing*, Shanghai, China, Oct 2005.
  - **“Emerging Video Understanding Technologies and Applications,”** *IEEE Intl. Symposium on Circuits & Systems (ISCAS)*, Kobe, Japan, May 2005.
  - **“Emerging Multimedia Security Technologies for Digital Rights Management,”** *IEEE Intl. Conf. on Consumer Electronics (ICCE)*, Las Vegas, Jan. 2005.
  - **“Multimedia Security Technologies for Digital Rights Management,”** *IEEE Global Communication Conference (Globecom)*, San Francisco, Dec 2003.
  - **“Multimedia Security Technologies for Digital Rights Management,”** *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Baltimore, July 2003.
  - **“Lossless Data Hiding,”** *IEEE Intl. Symposium on Circuits & Systems (ISCAS)*, Bangkok, May 2003.
  
- **Conference Special Session Organizer:**
  - **“Content Understanding and Transcoding Techniques for Media Adaptation,”** *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Taipei, June 2004;

- **“The Role of Machine Learning in Extracting Semantics from Multimedia Content,”** *IEEE Intl. Conf. on Image Processing (ICIP)*, Barcelona, September 2003;
  - **“Emerging Multimedia Security Technologies for Digital Rights Management,”** *IEEE Intl. Conf. on Multimedia & Expo (ICME)*, Taipei, June 2004;
  - **“Media Security Issues in Streaming and Mobile Applications,”** *IEEE Intl. Conf. on Image Processing (ICIP)*, Singapore, October 2004;
  - **“Multimedia Security and Watermarking Applications,”** *IEEE Intl. Conf. on Information Technology: Coding and Computing (ITCC)*, Las Vegas, April 2001.
- **Academic Interactions:**
    - **“111 Project” Advisory Board** – Shanghai Jiaotong University, 2007-2009.
    - **Visiting Associate Professor** – Dept. of Computer Science, National Taiwan University, November 2006.
    - **Visiting Associate Professor** – Dept. of Computer Science, National Taiwan University, December 2005.
    - **International Advisory Board** – Dept. of Electrical Engineering, National Cheng-Kung University, Tainan, Taiwan, 2004–2006.
    - **Course/ Short Lecture,**
      - (Course 3pt) **“Network Science,”** Dept. of Electrical Engineering, Columbia University, Fall 2010.
      - (Course 3pt) **“Multimedia Security Systems,”** Dept. of Electrical Engineering, Columbia University, Spring 2005, Summer 2005, Spring 2006, Summer 2007.
      - (Lecture 12 hrs) **“Multimodality Signal Understanding and Computational social science,”** Dept. of Computer Science, National Taiwan University, December 2005.
      - (Lecture 8 hrs) **“Multimedia Understanding and Multimedia Security,”** Dept. of Computer Science, National Tsinghua University, Nov. 2003.
      - (Lecture 3 hrs) **“Statistical Methods for Video Indexing and Analysis,”** Dept. of Electrical Engineering, Columbia University, Oct. 2003.
      - (Lecture 6 hrs) **“Multimedia Security in Visual Information Systems,”** Dept. of Electrical Engineering, Columbia University, Nov. 2001 & Nov. 2002.
    - **IBM Research Student Fellowship Committee** – IBM Research, 2004.
    - **IBM Research External Multimedia Seminar Co-Organizer** – IBM Research, 2004 - 2005.
- **Memberships, Technical Committee Memberships, and Reviewers:**
    - *IEEE Senior Member* ('04 - , *Member* '96-'97, '01-'03, *Student Member* '98-'00)
    - *Academy of Management* ('11 - )
    - *ACM Member* ('01 - , *Student Member* '98 – '00 )
    - *IEEE Communication Society Multimedia Technical Committee* ('02-),
    - *IEEE Circuits and Systems Society Visual Signal Processing Technical Committee* ('03-),

- *IEEE Circuits and Systems Society Multimedia System and Application Technical Committee ('03-)*,
- *IEEE Signal Processing Society Multimedia Signal Processing Technical Committee ('06-'09)*,
- *ACM SIG Multimedia ('01-)*,
- *ACM SIG Knowledge Discovery and Data mining ('05-)*,
- *American Association for the Advancement of Science (AAAS) ('05 - )*
- *International Network for Social Network Analysis (INSNA) ('05 - )*
- **Journal/Magazine/Book Reviewer:** *More than 40 international journals, magazines, and books, including IEEE Trans. on Multimedia, IEEE Trans. on Image Processing, IEEE Trans. on Circuits and Systems for Video Technology, IEEE Trans. on Signal Processing, IEEE Trans. on Signal Processing Letters, IEEE Multimedia Magazine, IEEE Signal Processing Magazine, IEEE Communications Magazine, ACM Multimedia System Journal, SPIE Journal of Visual Communication and Image Representation.... (not a complete list)*
- **Invited Talks:** *More than 30 invited seminar talks, including Columbia University, Univ. of Washington, Univ. of Michigan, New Jersey Institute of Technology, Stevens Institute of Technology, NEC Research, Panasonic Research, Sony Research, Microsoft Research, National University of Singapore, Institute of Information Research, Sinica Academics, Taiwan University, Tsinghua University, Taiwan Normal University, Chiao-Tung University, Cheng-Kung University.... (not a complete list)*

## Student Advisees

- **Ph.D. Thesis Co-Advisor:**

- **Dr. Xiaodan Song**, *Dept. of Electrical Engineering, Univ. of Washington*. Thesis Title: Exploring Dynamic Patterns for Recommendation. [graduated -- August 2006, currently in Google Labs, Mt. View, CA.]
- **Ya-Ti Peng**, *Dept. of Electrical Engineering, Univ. of Washington*. Thesis Title: Multimodal Signal Processing for Healthcare Application. [graduated 2008, currently in Intel Labs, Santa Clara, CA.]
- **Jyh-Ren Shieh**, *Dept. of Computer Science, National Taiwan Univ.* Thesis Title (temporary): Semantic Search Expansion based on Multimodality Relationships. [expected 2011]

- **Master Student Research Projects:**

- **Victor Sutan**, *Dept. of Electrical Engineering, Columbia University, May 2005 ~ Jan 2006*. Project Title: Developing Smart Semantic Video Camera for Contextual Environmental Cognition – Signal Acquisition.
- **Jason Cardillo**, *Dept. of Electrical Engineering, Columbia University, May 2005 ~ Jan 2006*. Project Title: Developing Smart Semantic Video Camera for Contextual Environmental Cognition – Compressed Video Stream Processing.
- **Wesley Hsu**, *Dept. of Electrical Engineering, Columbia University, Sep 2006 ~ May 2007*. Project Title: Personalized Movie Recommender.
- **Chin-Sheng Chen**, *Dept. of Electrical Engineering, Columbia University, , Sep 2006 ~ May 2007*. Project Title: Expertise Search Engine based on publications.

- **Wan-Ting Lee**, *Dept. of Electrical Engineering, Columbia University*, , Sep 2006 ~ Jan. 2007. Project Title: H.264 Video Encoder.
  
- **Advising Interns at IBM Watson Research Center:**
  - **Helena Buhr**, *Northwestern University Kellogg Management*, May ~ Aug 210. Project Title: Evolution of Social Networks.
  - **U Kang**, *School of Machine Learning, Carnegie Mellon University*, May ~ Aug 210. Project Title: Large-Scale and Real-Time Network Analysis.
  - **David Hsu**, *Dept. of Computer Science, University of Minnesota*, Jun ~ Aug 210. Project Title: Classification and Clustering utilizing Super Computer.
  - **Lynn Wu**, *MIT Sloan Management School*, June ~ Sept 2008, Jan ~ March 2009. Project Title: Value of Social Network.
  - **Navneet Panda**, *Dept. of Electrical and Computer Engineering, Univ. of California, Santa Barbara*, June ~ Sept 2005. Project Title: Speeding Up Support Vector Machine Classification.
  - **Gang Wu**, *Dept. of Electrical and Computer Engineering, Univ. of California, Santa Barbara*, June ~ Sept. 2004. Project Title: Machine Learning from Imperfect Labeling.
  - **Dongqing Zhang**, *Dept. of Electrical Engineering, Columbia University*, May ~ Aug 2003. Project Title: Multi-channel Multimedia Semantic Correlation in the Concept Space.
  - **Vida Ha**, *Dept. of Electrical Engineering and Computer Science, MIT*, May ~ Aug 2001. Project Title: Pervasive Video Streaming Clients on Palm PDA Devices.
  
- **Advising Postdocs at IBM Watson Research Center:**
  - **Yingzi Jin**, *University of Tokyo*, May 2009 ~ April 2010. Project Title: Financial Impact of Company Networks.
  - **Yusuke Matsumura**, *Hokkaido University*, Sept 2009 ~ August 2011. Project Title: Network Optimization
  - **Fuyuko Ito Matsumura**, *Doshisha University*, May 2010 ~ August 2011. Project Title: Evolutionary User Modeling

## Granted Recent Research Project Proposals

- **Anomaly Detection at Multiple Scales (PI)**, DARPA, April 2011 – March 2013.
- **Finding Expertise on the Internet (PI)**, Shell Labs, April 2011 – March 2013.
- **Value of Networks (PI)**, Social and Cognitive Network Science Academic Research Center, Oct 2009 – Sept. 2019.
- **Smarter Campus (PI)**, IBM Software Strategy, 2011.
- **Social selling & marketing for B2B (PI)**, IBM Software Industry Solution, 2011.

- **People Analytics for Cyber Security (PI)**, Cyber Security Research Center, 2011 - present.
- **Expertise Search and Social Network Analysis (PI)**, IBM, June 2006 – present.
- **Multimodality Sensor Signal Understanding on Human Activities (Co-PI)**, Institute of Information Industry (granted to the Univ. of Washington), Jan. 2006 – Dec. 2008.
- **Multimodality Sensor Fusion for Health Care Applications (Co-PI)**, Institute of Information Industry (granted to the Univ. of Washington), June 2005 – Dec. 2005.
- **Building Evolutionary Graphical Models for Expertise and Community Mining (PI)**, NEC Labs America (granted to the Univ. of Washington), Sept. 2004 – May 2006.
- **Reconstructing and Mining Semantic Threads across Multiple Video News Sources over Space and Time (Co-PI)**, Intelligence Community -- Advanced Research and Development Activity (ARDA), IARPA, June. 2004 – June. 2006.
- **Pervasive Transcoding Middleware for Geospatial Intelligence Access**, Defense Information System Agency (DISA), Jan. 2003 – Feb. 2004.
- **Multimedia Semantic Mining**, IBM Adventure Research Fund, Aug. 2001 – Oct. 2004.

## **Selected Publications (3,476 citations in Google Scholar; 1,949 citations of first-author papers)**

**[2011]:**

### ***Conference Papers***

1. Hanghang Tong and Ching-Yung Lin, “**Non-Negative Residual Matrix Factorization with Application to Graph Anomaly Detection**,” *SIAM Data Mining Conference, Mesa, AZ*, April 2011.
2. Dashun Wang, Zhen Wen, Hanghang Tong, Ching-Yung Lin, Chaoming Song, and Albert-Laszlo Barabasi, “**Information Spreading in Context**”, *the 20<sup>th</sup> Intl. WWW Conf.*, Hyderabad, India, March 2011.

### ***Journal/Magazine Papers***

3. Ja-Hwung Su, Ching-Yung Lin and Vincent Tseng. “**Effective Semantic Annotation by Image-Concept Distribution Model**,” *IEEE Trans. on Multimedia*, 2011.

**[2010]:**

### ***Conference Papers***

4. Jyh-Ren Shieh, Ching-Yung Lin, Shun-Xuan Wang, Yung-Huan Hsieh, and Ja-Ling Wu, “**Incorporating Multi-Partite Networks and Expertise to Construct Related-Term Graph**,” IEEE Intl. Workshop on Semantic Aspects in Data Mining, Sydney, Australia, Dec. 2010.
5. Zhen Wen, Dashun Wang and Ching-Yung Lin, “**Unlock Collective Intelligence from Information Flows in Social Networks**,” *Network Science Workshop*, West Point, NY, Oct. 2010.

6. Zhen Wen and Ching-Yung Lin, “**On the Quality of Inferring Interests from Social Neighbors**,” *ACM SIGKDD Intl. Conf. on Knowledge Discovery and Data Mining*, Washington DC, July 2010.
7. Ja-Hwung Su, Chien-Li Chou, Ching-Yung Lin and Vincent S. Tseng, “**Effective Image Semantic Annotation by Discovering Visual-Concept Associations from Image-Concept Distribution Model**,” *IEEE Intl. Conf. on Multimedia and Expo*, Singapore, July 2010.
8. Zhen Wen and Ching-Yung Lin, “**Towards Finding Valuable Topics**,” *SIAM Intl. Conf. on Data Mining (SDM)*, Columbus, OH, April 2010.
9. Zhen Wen and Ching-Yung Lin, “**How Accurately Can One’s Interests be Inferred from Friends**” *the 19<sup>th</sup> Intl. WWW Conf.*, Raleigh, NC, April 2010.

**[2009]:**

**Conference Papers**

10. Zhen Wen and Ching-Yung Lin, “**Using Social Networks, Content and Revenue Analysis to Find Valuable Topics in Enterprise**,” *Workshop on Information in Networks*, New York, NY, Sept 2009.
11. Ya-Ti Peng, Ching-Ying Lin, Ming-Ting Sun, and Kun-Cheng Tsai, “**Healthcare Audio Event Classification Using Hidden Markov Models**,” *IEEE Intl. Conf. on Multimedia and Expo*, New York, NY, June 2009.
12. Jimeng Sun, Spiros Papadimitriou, Ching-Yung Lin, Nan Cao, Shixia Liu, Weihong Qian, “**MultiVis: Content-Based Social Network Exploration through Multi-way Visual Analysis**,” *SIAM Intl. Conf. on Data Mining (SDM)*, Sparks, NV, April 2009.
13. Jyh-Ren Shieh, Yung-Huan Hsieh, Yang-Ting Yeh, Tse-Chung Su, Ching-Yung Lin, Ja-Ling Wu, “**Building term suggestion relational graphs from collective intelligence**,” *the 18<sup>th</sup> Intl. WWW Conf.*, Madrid, Spain, April 2009.
14. Lei Shi, Nan Cao, Shixia Liu, Weihong Qian, Li Tan, Guodong Wang, Jimeng Sun and Ching-Yung Lin, “**HiMap: Adaptive Visualization of Large-Scale Online Social Networks**”, *IEEE Pacific Visualization Symposium*, Beijing, China, April 2009.
15. Ching-Yung Lin, Nan Cao, Shixia Liu, Spiros Papadimitriou, Jimeng Sun, Xifeng Yan, “**SmallBlue: Social Network Analysis for Expertise Search and Collective Intelligence**,” *IEEE Intl. Conference on Data Engineering (ICDE)*. Shanghai China, March 2009.
16. Lynn Wu, Ching-Yung Lin, Sinan Aral, Erik Brynjolfsson “**Value of Social Network -- A Large-Scale Analysis on Network Structure Impact to Financial Revenues of Information Technology Consultants**,” *Winter Information Systems Conference*, Salt Lake City, UT, Feb. 2009.

**[2008]:**

**Journal/Magazine Papers**

17. Ching-Yung Lin, Kate Ehrlich, Vicky Griffiths-Fisher, and Christopher Desforges “**SmallBlue: People Mining for Expertise Search**,” *IEEE Multimedia Magazine*, Jan.-Mar. 2008.

**Conference Papers**

18. Ya-Ti Peng, Ching-Yung Lin and Ming-Ting Sun, "**Data Scaling Classification in Stream Analysis Systems**," *IEEE Intl. Conf. on Multimedia and Expo*, Hannover, Germany, June 2008.
19. Jyh-Ren Shieh, Yang-Ting Yeh, Chih-Hung Lin, Ching-Yung Lin and Ja-Ling Wu, "**Using Semantic Graphs for Image Search**," *IEEE Intl. Conf. on Multimedia and Expo*, Hannover, Germany, June 2008.
20. Ya-Ti Peng, Ching-Yung Lin and Ming-Ting Sun, "**Audio Event Classification Using Binary Hierarchical Classifiers with Feature Selection for Healthcare Applications**," *IEEE Intl. Symp. on Circuits and Systems*, Seattle, WA, May 2008.
21. Jyh-Ren Shieh, Yang-Ting Yeh, Chih-Hung Lin, Ching-Yung Lin and Ja-Ling Wu, "**Collaborative Knowledge Semantic Graph Image Search**," the 17<sup>th</sup> Intl. *WWW Conf.*, Beijing, China, April 2008.

**[2007]:**

#### **Journal/Magazine Papers**

22. Ya-Ti Peng, Ching-Yung Lin, Ming-Ting Sun and Carol Landis, "**Multimodality Sensor System for Long-Term Sleep Quality Monitoring**," *IEEE Trans. on Biomedical Circuits and System*, 2008.
23. Deepa Kundur, Ching-Yung Lin, and Chun-Shien Lu, "**Visual Sensor Networks**," *EURASIP Journal on Advances in Signal Processing*, 2007.

#### **Conference Papers**

24. Kate Ehrlich, Ching-Yung Lin and Vicky Griffiths-Fisher, "**Searching for experts in the enterprise: Combining text and social network analysis**," *ACM Group Conference*, Sanibel Island, FL, November 2007.
25. Ching-Yung Lin, "**Information Flow Prediction by Modeling Dynamic Probabilistic Social Network**," *Intl. Conf. on Network Science*, New York City, NY, May 2007.
26. Ching-Yung Lin, Kate Ehrlich and Vicky Griffiths-Fisher, "**Small Blue: Making Big Blue a Small World with social sensors, expertise search and social network analysis**," *Sunbelt 27th Intl. Social Network Conf.*, Corfu Island, Greece, May 2007.

**[2006]:**

#### **Book**

27. Wenjun Zheng, Heather Yu and Ching-Yung Lin, "**Multimedia Security Technologies for Digital Rights Management**," *Elsevier*, June 2006.

#### **Conference Papers**

28. Xiaohui Gu, Zhen Wen, Ching-Yung Lin and Philip S Yu, "**ViCo: An Adaptive Distributed Video Correlation System**," *ACM Multimedia Conference*, Santa Barbara, CA, October 2006.
29. Xiaodan Song, Belle L. Tseng, Ching-Yung Lin and Ming-Ting Sun, "**Personalized Recommendation Driven by Information Flow**," *ACM SIGIR Conference*, Seattle, WA, August 2006.
30. Victor Sutan, Jason Cardillo and Ching-Yung Lin, "**Developing Smart Video Semantic Sensors**," *IEEE Intl. Symposium on Circuits and Systems*, Kos Island, Greece, May 2006.

31. Ya-Ti Peng, Ching-Yung Lin, Ming-Ting Sun and Ming-Whei Feng, “**Sleep Condition Inferencing Using Simple Multimodality Sensors**,” *IEEE Intl. Symposium on Circuits and Systems*, Kos Island, Greece, May 2006.
32. Xiaodan Song, Ching-Yung Lin, Belle L. Tseng and Ming-Ting Sun, “**Modeling Evolutionary and Relational Behaviors for Community-based Dynamic Recommendation**,” *SIAM Data Mining Conference*, Bethesda, MD, April 2006.
33. Ching-Yung Lin, Xiaodan Song, Ming-Ting Sun and Belle L. Tseng, “**Automatic Modeling of Social Networks through Content Analysis of Communications**,” *Sunbelt 26th Intl. Social Network Conf.*, Vancouver, Canada, April 2006.
34. Ya-Ti Peng, Ching-Yung Lin and Ming-Ting Sun, “**Multimodality Sensors for Sleep Quality Monitoring and Logging**,” *1st IEEE Workshop on Electronic Chronicles*, Atlanta, GA, April 2006.
35. Ya-Ti Peng, Ching-Yung Lin and Ming-Ting Sun, “**A Distributed Multimodality Sensor System for Home-Used Sleep Condition Inference and Monitoring**,” *IEEE/AMA/BMES Transdisciplinary Conference on Distributed Diagnose and Home Healthcare*, Arlington, VA, April 2006.

### **Book Chapters**

36. Tian-Tsong Ng, Shih-Fu Chang, Ching-Yung Lin and Qibin Sun, “**Passive-Blind Image Forensics**” in *Multimedia Security Technologies for Digital Rights Management*, Elsevier, April 2006.

**[2005]:**

### **Conference Papers**

37. Xiaodan Song, Ching-Yung Lin and Ming-Ting Sun, “**Multimodality Concept Detectors on News Video**,” *Proc. of NIST Workshop on Text Retrieval Conf. (TRECVID)*, Gaithersburg, MD, November 2005.
38. Xiaodan Song, Ching-Yung Lin, Belle L. Tseng and Ming-Ting Sun, “**Modeling and Predicting Personal Information Dissemination Behavior**,” *ACM SIGKDD Intl. Conf. on Knowledge Discovery and Data Mining*, Chicago, August 2005. (**KDD 2005 Student Travel Award**)
39. Ching-Yung Lin, Olivier Verscheure and Lisa Amini, “**Semantic Routing and Filtering for Large-Scale Video Streams Monitoring**,” *IEEE Intl. Conf. on Multimedia & Expo*, Amsterdam, Netherlands, July 2005.
40. Xiaodan Song, Ching-Yung Lin and Ming-Ting Sun, “**Speech-based Video Retrieval Using WordNet**,” *IEEE Intl. Conf. on Multimedia & Expo*, Amsterdam, Netherlands, July 2005.
41. Xiaodan Song, Belle L. Tseng, Ching-Yung Lin and Ming-Ting Sun, “**ExpertiseNet: Relational and Evolutionary Expert Modeling**,” *Intl. Conf. on User Modeling*, Edinburgh, UK, July 2005. (**US National Science Foundation UM05 Student Travel Award**)
42. Ching-Yung Lin and Belle L. Tseng, “**Optimizing User Expectations for Video Semantic Filtering and Abstraction**,” *IEEE Intl. Symposium on Circuits and Systems*, Kobe, Japan, May 2005.
43. Xiaodan Song, Ching-Yung Lin and Ming-Ting Sun, “**Autonomous Learning of Visual Concept Models**,” *IEEE Intl. Symposium on Circuits and Systems*, Kobe, Japan, May 2005.
44. Lexing Xie, L. Kennedy, Shih-Fu Chang, Ajay Divakaran, Huifan Sun and Ching-Yung Lin, “**Layered Dynamic Mixture Model for Pattern Discovery in Asynchronous Multi-Modal Streams**,” *IEEE Intl. Conf. on Acoustics, Speech, and Signal Processing*, Philadelphia, PA, March 2005. (**Special Outstanding Paper Recommendation**)

45. Ching-Yung Lin, Xiaodan Song and Gang Wu, “**Imperfect Learning for Autonomous Concept Modeling**,” *SPIE EI 2005 – Storage and Retrieval for Media Databases*, San Jose, January 2005.

### *Journal/Magazine Papers*

46. Qibin Sun, Shuiming Ye, Ching-Yung Lin and Shih-Fu Chang, “**A Crypto Signature Scheme for Image Authentication over Wireless Channel**,” *Intl. Journal of Image and Graphics*, January 2005.

**[2004]:**

### *Conference Papers*

47. A. Amir, J. Argillander, M. Berg, S.-F. Chang, W. Hsu, G. Iyengar, J. Kender, Ching-Yung Lin, M. Naphade, A. Natsev, J. R. Smith, J. Tesic, G. Wu, R. Yan and D. Zhang, “**IBM Research TRECVID-2004 Video Retrieval System**,” *Proc. NIST Text Retrieval Conf. Video (TRECVID)*, Gaithersburg, MD, November, 2004.
48. Yi Wu, Ching-Yung Lin, Edward Chang, and John R. Smith, “**Multimodal Kernel Fusion for News Video Concept Detection**,” *IEEE Intl. Conf. on Image Processing*, Singapore, October 2004.
49. Lexing Xie, L. Kennedy, Shih-Fu Chang, Ajay Divakaran, Huifan Sun and Ching-Yung Lin, “**Discovering Meaningful Multimedia Patterns with Audio-Visual Concepts and Associated Text**,” *IEEE Intl. Conf. on Image Processing*, Singapore, October 2004. (*Student Paper Award*)
50. Xiaodan Song, Ching-Yung Lin and Ming-Ting Sun, “**Autonomous Visual Model Building Based on Image Crawling through Internet Search Engines**,” *The ACM Workshop on Multimedia Information Retrieval*, New York, October 2004. (*Student Travel Award, University of Washington, School of Engineering*)
51. Xiaodan Song, Ching-Yung Lin and Ming-Ting Sun, “**Cross-Modality Automatic Face Model Training from Large Video Databases**,” *The 1<sup>st</sup> IEEE Workshop on Face Processing in Video*, D.C., June 2004.
52. Ching-Yung Lin and Belle L. Tseng, “**Semantic Multimedia Authentication with Model Vector Signature**,” *IEEE Intl. Conf. on Multimedia & Expo*, Taipei, June 2004.
53. Ching-Yung Lin, Apostol Natsev, Belle L. Tseng, Matthew Hill and John R. Smith, “**Pervasive Transcoding Middleware for Geospatial Intelligence Access**,” *IEEE Intl. Conf. on Multimedia & Expo*, Taipei, June 2004.
54. Dongqing Zhang, Ching-Yung Lin and John R. Smith, “**Semantic Video Clustering across Sources using Bipartite Spectral Clustering**,” *IEEE Intl. Conf. on Multimedia & Expo*, Taipei, June 2004.
55. Milind Naphade, Apostol Natsev, Ching-Yung Lin and John R. Smith, “**Multi-Granular Detection of Regional Semantic Concepts**,” *IEEE Intl. Conf. on Multimedia & Expo*, Taipei, June 2004.
56. Qibin Sun, Shuiming Ye, Ching-Yung Lin and Shih-Fu Chang, “**A Crypto Signature Scheme for Image Authentication over Wireless Channel**,” *IEEE Intl. Conf. on Multimedia & Expo*, Taipei, June 2004.
57. Winston Hsu, L. Kennedy, C.-W. Huang, S.-F. Chang, Ching-Yung Lin and G. Iyengar, “**News Video Story Segmentation using Fusion of Multi-Level Multi-Modal Features in TRECVID**,” *IEEE Intl. Conf. on Acoustics, Speech, and Signal Processing*, Montreal, May 2004.
58. A. Amir, G. Iyengar, Ching-Yung Lin, M. Naphade, A. Natsev, C. Neti, H. J. Jock, J. R. Smith, B. L. Tseng, “**Multimodal Video Search Techniques: Late Fusion of Speech-based Retrieval and Visual Content-based Retrieval**,” *IEEE Intl. Conf. on Acoustics, Speech, and Signal Processing*, Montreal, May 2004.

59. John R. Smith, Ching-Yung Lin, Milind Naphade, Apostol Natsev and Belle L. Tseng, "**Validity Weighted Model Vector-based Retrieval of Video**," *SPIE EI 2004 – Storage and Retrieval for Media Databases*, San Jose, January 2004.
60. Winston Hsu, Shih-Fu Chang, Chih-Wei Huang, Lyndon Kennedy, Ching-Yung Lin and Giri Iyengar, "**Discovery and Fusion of Salient Multi-modal Features towards news Story Segmentation**," *SPIE EI 2004 – Storage and Retrieval for Media Databases*, San Jose, January 2004.

### ***Journal/Magazine Papers***

61. Arnon Amir, Sankar Basu, Giri Iyengar, Ching-Yung Lin, Milind Naphade, John R. Smith, Savitha Srinivasan and Belle L. Tseng, "**A Multi-modal System for the Retrieval of Semantic Video Events**," *Journal of Computer Vision and Image Understanding*, July 2004.
62. Deepa Kundur, Ching-Yung Lin, Benoit Macq and Heather Yu, "**Scanning the Special Issue on Enabling Security Technologies for Digital Rights Management**," *Proceedings of the IEEE*, June 2004.
63. Belle L. Tseng, Ching-Yung Lin and John R. Smith, "**Video Personalization and Summarization System for Usage Environment**," *Journal of Visual Communications and Image Representation*, May 2004.
64. Belle L. Tseng, Ching-Yung Lin and John R. Smith, "**Using MPEG-7 and MPEG-21 for Personalizing Video**," *IEEE Multimedia Magazine*, Jan.-Mar., 2004.

### ***Book Chapters***

65. Xiaodan Song, Ching-Yung Lin, and Ming-Ting Sun, "**Cross-Modality Autonomous Concept Learning**" in *Multimedia Neural Network*, Springer, Sept. 2004.
66. John. R. Smith, Ching-Yung Lin, Milind Naphade and Apostol Natsev, "**Multisource Video Clustering Using Semantic Model Vectors**" in *Multimedia Information Retrieval*, AIDA informazioni, March 2004.
67. Ching-Yung Lin, "**Issues on Multimedia Authentication**," in *Multimedia Security: steganography and digital watermarking techniques for protection of intellectual property*, IGP, March 2004.
68. Deepa Kundur, Heather Yu, and Ching-Yung Lin, "**Security and Digital Rights Management for Mobile Content**," in *Content Delivery in Mobile/ Wireless Internet*, Chapter 13, John Wiley & Sons, 2004.

**[2003]:**

### ***Conference Papers***

69. Ching-Yung Lin, Belle L. Tseng and John R. Smith, "**Video Collaborative Annotation Forum: Establishing Ground-Truth Labels on Large Multimedia Datasets**," *Proc. of NIST Text Retrieval Conf. (TREC)*, Gaithersburg, MD, November 2003.
70. A. Amir, W. Hsu, G. Iyengar, Ching-Yung Lin, M. Naphade, A. Natsev, C. Neti, H. J. Nock, J. R. Smith, B. L. Tseng, Y. Wu, D. Zhang, "**IBM Research TRECVID-2003 System**," *Proc. NIST Text Retrieval Conf. (TREC)*, Gaithersburg, MD, November, 2003.
71. Ching-Yung Lin, Belle L. Tseng, Milind Naphade, Apostol Natsev and John R. Smith, "**MPEG-7 Video Automatic Labeling System**," *ACM Multimedia*, November 2003.
72. C.-S. Li, C. Aggarwal, M. Campbell, Y.-C. Chang and G. Glass, V. Iyengar, M. Joshi, Ching-Yung Lin, M. Naphade, J. R. Smith, B. Tseng, M. Wang, K.-L. Wu, P. S. Yu, "**EpiSPIRE: A system for environmental and public health monitoring**," *Dept. of Homeland Security Advanced Scientific Computing (ASC) Requirements Workshop*, Crystal City, VA, October, 2003.

73. John R. Smith, Ching-Yung Lin and Belle L. Tseng, "**Multimedia resource transcoding for MPEG-21 digital item adaptation**," *Proc. SPIE ITCOM: Internet Multimedia Management Systems IV*, Orlando, FL, September 2003.
74. Ching-Yung Lin, Belle L. Tseng, Milind Naphade, Apostol Natsev and John R. Smith, "**VideoAL: A Novel End-to-End MPEG-7 Automatic Labeling System**," *IEEE Intl. Conf. on Image Processing*, Barcelona, September 2003.
75. Belle L. Tseng, Ching-Yung Lin, Milind Naphade, Apostol Natsev and John R. Smith, "**Normalized Classifier Fusion for Semantic Visual Concept Detection**," *IEEE Intl. Conf. on Image Processing*, Barcelona, September 2003.
76. John R. Smith, Alejandro Jaimes, Ching-Yung Lin, Milind Naphade, Apostol Natsev and Belle L. Tseng, "**Interactive Search Fusion Methods for Video Database Retrieval**," *IEEE Intl. Conf. on Image Processing*, Barcelona, Sep. 2003.
77. Dongqing Zhang, Belle L. Tseng, Ching-Yung Lin and Shih-Fu Chang, "**Accurate Overlay Text Extraction for Digital Video Analysis**," *IEEE Intl. Conf. on Information Technology: Research and Education*, Newark, Aug. 2003.
78. Harriet Nock, Giri Iyengar, Ching-Yung Lin, Milind Naphade, Apostol Natsev, Chalapathy Neti, John R. Smith, and Belle L. Tseng, "**User-trainable Video Annotation using Multimodal Cues**," *ACM SIGIR*, Toronto, Canada, July 2003.
79. Ching-Yung Lin, Belle L. Tseng and John R. Smith, "**VideoAnnEx: IBM MPEG-7 Annotation Tool for Multimedia Indexing and Concept Learning**," *IEEE Intl. Conf. on Multimedia & Expo*, Baltimore, July 2003.
80. Belle L. Tseng, Ching-Yung Lin, Dongqing Zhang and John R. Smith, "**Improved Text Overlay Detection in Videos Using a Fusion-Based Classifier**," *IEEE Intl. Conf. on Multimedia & Expo*, Baltimore, July 2003.
81. Milind Naphade, Ching-Yung Lin, Belle L. Tseng, Apostol Natsev and John R. Smith, "**A Framework for Moderate Vocabulary Semantic Video Concept Detection**," *IEEE Intl. Conf. on Multimedia & Expo*, Baltimore, July 2003.
82. Chung-Sheng Li, C. Aggrarwal, M. Campbell, Y.-C. Chang, G. Glass, V. Iyengar, M. Joshi, Ching-Yung Lin, M. Naphade, J. R. Smith, B. L. Tseng, M. Wang, K.-L. Wu, and P. Yu, "**EPI-SPIRE: A Bio-Surveillance System for Environmental and Public Health Activity Monitoring**," *IEEE Intl. Conf. on Multimedia & Expo*, Baltimore, July 2003.

### ***Journal/Magazine Papers***

83. Ching-Yung Lin and Shih-Fu Chang, "**Robust Digital Signature for Multimedia Content Authentication: A Summary**," *IEEE Circuits and Systems Magazine*, October 2003.
84. Bill Adams, Giri Iyengar, Ching-Yung Lin, Milind Naphade, Chalapathy Neti, Herriet Nock and John R. Smith, "**Semantic Indexing of Multimedia Content Using Visual, Audio and Text Cues**," *EURASIP Journal on Applied Signal Processing*, 2003

### ***Book Chapters***

85. John. R. Smith, Ching-Yung Lin, Milind Naphade, Apostol Natsev and Belle L. Tseng, "**Statistical Techniques for Video Analysis and Searching**," in *Video Mining*, Chapter 9, Kluwer Academic Publishers, 2003.

[2002]:

**Conference Papers**

86. Ching-Yung Lin and Belle L. Tseng, "**Segmentation, Classification, and Watermarking for Multimedia Semantic Authentication**," *IEEE Intl. Workshop on Multimedia Signal Processing*, US Virgin Islands, Dec. 2002.
87. Belle L. Tseng and Ching-Yung Lin, "**Personalized Video Summary using Visual Semantic Annotations and Automatic Speech Transcriptions**," *IEEE Intl. Workshop on Multimedia Signal Processing*, US Virgin Islands, Dec. 2002.
88. Belle L. Tseng, Ching-Yung Lin and John R. Smith, "**Video Personalization and Summarization System**," *IEEE Intl. Workshop on Multimedia Signal Processing*, US Virgin Islands, Dec. 2002.
89. B. Adams, A. Amir, C. Dorai, S. Ghosal, G. Iyengar, A. Jaimes, C. Lang, Ching-Yung Lin, A. Natsev, C. neti, H. J. Nock, H. Permuter, R. Singh, J. R. Smith, S. Srinivasan, B. L. Tseng, AT Varadaraju and D. Zhang, "**IBM Research TREC-2002 Video Retrieval System**," *NIST TREC-11 Text Retrieval Conference*, Gaithersburg, MD, Nov. 2002.
90. John R. Smith, Ching-Yung Lin, Milind Naphade, Apostol Natsev, and Belle L. Tseng, "**Statistical Modeling and Retrieval of Video Content**," *DIMACS Workshop on Video Mining*, Rutgers Univ., NJ, Nov. 2002.
91. John R. Smith, Ching-Yung Lin, and Milind Naphade, "**Video Texture Indexing using Spatio-Temporal Wavelets**," *IEEE Intl. Conf. on Image Processing*, Rochester, NY, Sep. 2002.
92. John R. Smith, Sankar Basu, Ching-Yung Lin, Milind Naphade, and Belle L. Tseng, "**Interactive Content-based Retrieval of Video**," *IEEE Intl. Conf. on Image Processing*, Rochester, NY, Sep. 2002
93. Milind Naphade, Sankar Basu, John R. Smith, Ching-Yung Lin, and Belle L. Tseng, "**Modeling Semantic Concepts to Support Query by Keywords in Video**," *IEEE Intl. Conf. on Image Processing*, Rochester, NY Sep. 2002.
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My main research thrust is *Multimodality Signal Understanding and Computational Social Science*. The objective is to advance scientific progress on making machines to understand and learn from observable multimodality sensing data, and then focus on automatically modeling of humanities and societies to help advance social science researches.

We argue that human intrinsic characteristics and extrinsic activities can be somewhat observable by their expressions captured by multimodality signals, such as video, speech, email, instant messaging, sensor signals, web access records, activity logs, *etc.* If humanity can be automatically observed and interpreted by machine, we see the twilight of solving a long-haunted data collection issue in various disciplines of social science. Social science disciplines, such as sociology, organization management, political science, pedagogy, anthropology, psychology, *etc.*, usually rely on questionnaires to explore the internal mind of subjects and researchers' observations to recognize behavior. In most scenarios, such methods are time- and resource-consuming, incomplete, and influenced by individual subjective observers. Thus, most theories and experiments in these fields can hardly be repeatedly examined.

Through *Multimodality Signal Understanding*, we expect to provide objective data collection and understanding mechanisms and mathematical classification methods to analyze social science variables with a more rigorous and repeatable manner. We shall adopt and develop machine learning approaches that were proved to be successful in multimedia understanding. There is an old saying – *a picture is worth a thousand words*. But, understanding which thousand words was previously considered a far-fetched goal for machines. Only until recent research progress showed the dawn of the possibility of machine understanding of visual and multimedia semantics. Our team has been promoting and demonstrating leading performance in understanding multimedia semantics through annual NIST TREC Video benchmark. We consider similar multimodality understanding technologies has great potential to be applied to the understanding of human and society, e.g., what human beings see, hear, sense, *etc.* We call this novel interdisciplinary research thread as *Computational social science*.

*Multimodality Signal Understanding* will be the main technical thrust of the lab. The merge of understanding human and understanding content represents the automatically understanding of what datum is meant to human. In order to organize, realize and extract intelligence out of the huge amount of continuous multimodality streams that a person, a company, or a community receives, we consider *real-world machine learning* and *distributed signal processing* as the keys. *Real-world machine learning* focuses on multimodality machine learning from imperfect and continuous sensing data. Their key technical challenge is to advance techniques on autonomous learning, noisy labeling learning and integrated learning. *Distributed signal processing* allows machine to classify large-scale data based on the learned models. In addition to the impacts on computational social science, understanding contents on *distributed sensor systems or information processing systems* can significantly reduce the communication loads by making decisions at various streaming stages. On *medical and healthcare* systems, we shall be able to provide novel hardware devices that gather information more intelligently and efficiently. *Privacy, security and information assurance* can be better achieved, if sensors can automatically remove or encrypt sensitive data before capturing or transmission.

In the following sections, I will further discuss the details of technical foundations of *Multimodality Signal Understanding* and its applications to *Computational social science*.

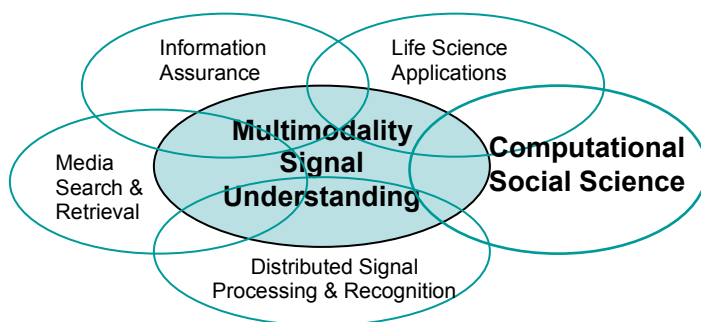


Figure 1: Interdisciplinary Researches of Multimodality Signal Understanding

## Multimodality Signal Understanding

The main goal of multimodality signal understanding is to transfer sensing/observable signals into semantic useful information. Its two major fundamental issues are *real-world multimodality machine learning* and *distributed signal processing and recognition*. I will also mention some potential applications other than computational social science.

### I. Real-World Multimodality Learning Machine

**Description:** We will investigate the theory, algorithm and system issues toward the construction of automatic cognitive learning machine. With the recent success of machine learning algorithms, many traditional thinking of system design may be re-examined via machine learning approaches. Under machine learning infrastructure, system designers no longer play the role of assigning rules but designing algorithms to allow systems to learn to solve problems by themselves. For instance, this approach has significantly increased the number of video concepts that machine can understand to the range of hundreds and have competitive accuracy with prior methods. We propose to create a new kind of learning system. These learning machines automatically capture data from multimodality sensing sources (audio, visual, text, etc), execute recognition, and then learn to infer more complicated concepts/knowledge. Also, the learning system can execute existing knowledge-base, e.g., electronic dictionary, to extend and connect concepts. We have been focusing on learning complex task automatically from self-observation. The learner must combine the limited observational data with domain knowledge, world knowledge, reasoning, and simulation in order to assemble the body of knowledge necessary to solve the real-world problems. The key technical thrust is to advance techniques on autonomous learning, noisy labeling learning and integrated learning.

**My prior works:** we proposed a novel Autonomous Learning mechanism, in which imperfect labeling information automatically extracted from cross-modality correlation is used for training. This totally avoids the need of manual labeling effort. Based on the computational statistic theory, we provide a theoretical foundation for the Autonomous Learning mechanism. Our video concept detection system is the best among 20 – 100 systems as benchmarked by NIST every year since 2002. Overall, I authored or co-authored 3 book chapter and 31 journal and conference papers in this area.

#### **Research projects:**

- **Machine Learning based on Imperfect Labeling:** Real-world learning indicates that labeling is usually generated via automatic schemes such as speech recognition, visual object detection, etc. Studying the effect of noisy labeling to various learning algorithms is a very important issue.
- **Continuous Reinforcement Learning:** Cognitive machine needs to remember and organized learnt knowledge in a systematic manner. We shall further investigate the appropriate continuous learning algorithms.
- **Multimodality Autonomous Learning:** In our original system prototype, we demonstrated that multimodality autonomous learning is possible. Machines can learn concepts automatically from TV programs or web images, with competitive modeling accuracy with supervised learning. We shall continue to investigate this thread.

### II. Distributed Signal Processing and Recognition

**Description:** We are seeing a trend that information filtering and mining from large scale of streams have becoming more and more important. In various aspects, e.g., data analysis, indexing, transmission, scheduling, storage, etc, most existing information management systems cannot handle the information overflow issues, once the scale exponentially explodes. Technology users demand machines to help them interpret the large amount of signals they receive. We consider multimodality recognition technology has to be integrated in the communication systems to help users to filter the data/information and, thus, significantly reduce the communication load to make many-to-one signal perception/mining possible.

**My prior works:** I am leading the IBM large-scale distributed video and multimedia information processing system projects. We implemented a real-time video semantic filtering system for filtering video packets in a rate of tens of Gbps. We also improved the speed of SVM classifiers and observed speed-up improvements of tens to thousand in our experiments. We have applied 3 patents, in these classified projects.

### III. Multimodality Understanding for Information Assurance and Multimedia Retrieval

**Description:** For the application on *Security and Information Assurance*, multimodality signal understanding techniques can make significant impact. Previous information assurance challenges were mostly focused on how to engineer secure systems for an environment of dynamic applications. However, consumer cares about the semantic integrity of the content, not the signal level integrity. For the *Privacy* issues, multimodality signal understanding can be applied to automatically recognize characteristics of streams and avoid recording sensitive data at the first stage.

People generate photos and videos, write emails and blogs, use VoIP phone and instant messaging, and look at webpages all the time. Finding appropriate information has been a very important task. Previously, we see link-based methods showed great success in the business models of Google. However, most multimedia data are still unstructured. To find them, content analysis is a must. Our past experience on content recognition positioned us in an excellent position on making significant impact in this field.

**My prior works:** Designed the first semi-fragile watermarking makes image sustaining malicious operations with self-recovery capability. Proved theorems that achieve the information-theoretic capacity bound based on human visual system. Designed the first MPEG-7 video collaborative annotation system and the main contributor of the IBM Research image retrieval system. I published 1 book, 3 book chapters and 25 journal and conference papers in multimedia security, and 1 book chapter and 17 journal and conference papers in information mining/retrieval area

### IV. Multimedia Security

A new economy based on information in digital form has emerged. People create, sell, and interact with multimedia content. The Internet provides a ubiquitous infrastructure for e-commerce; however, it does not provide enough protection for its participants. Lacking adequate protection mechanisms, content providers are reluctant to distribute their digital contents, because they can be easily re-distributed; content receivers are skeptical about the reality and integrity of content. Current technology in network security protects contents during one stage of transmission. But, it cannot protect multimedia data through multiple stages of transmission entities, including human beings and machines. These concerns have hindered the universal acceptance of digital multimedia. At the same time, they also stimulate a new research field: **multimedia security**.

My research interests are developing algorithms for various multimedia security applications and designing protocols for multimedia security systems. In general, multimedia security includes five major applications: *copyright protection*, *authentication*, *fingerprinting*, *info hiding*, and *hidden annotation*. All of them are based on **digital watermarking**, a technique that embeds extra information in multimedia data, while some objectives can be realized by **robust digital signature**. Different application drives different requirements in robustness, amount of embedded information, security, and imperceptibility.

#### Copyright protection

**Description:** Copyright protection is utilized by embedding the owner identification into the multimedia content. This embedded information (*i.e.*, watermark) has to be robust against attacks. Current watermarking techniques can survive various manipulations, with the presence of the source image. Recently, researchers are developing public watermarking techniques that do not need the source data. They are also designing techniques for other types of multimedia such as video, graph, audio, and document.

**My prior works:** Designed the first public watermarking scheme surviving print-and-scan process. I was the first researcher to model the distortion of digital images after print-and-scan, and the primary contributor to the design of a novel public watermarking method based on feature vector shaping.

#### Multimedia authentication

**Description:** Multimedia authentication techniques are used to verify the integrity of data, the alleged source of data, and/or the reality of data. They are based on the *semi-fragile watermarks* or *robust digital signature*. The state-of-the-art image authentication techniques can detect malicious manipulations, accept lossy compressions, and even roughly recover the changed area. The future directions in multimedia authentication

are to develop techniques for other types of multimedia, and to accept different kinds of manipulations, e.g., D/A transcoding process.

**My prior works:** Designed the first semi-fragile watermarking/ robust digital signature authentication method. It is based on my discovery of two invariant theorems of JPEG/MPEG that are used for generating and embedding authentication bits. One theorem shows a high capacity information hiding technique surviving standard compression. Hence, recovery information can be embedded in the image/video. My work on the Self-Authentication-and-Recovery Images which embeds watermarks into images to be (1) detecting malicious and content preserving operations, (2) detecting the specific areas that images are manipulations, (3) recover a proximity of the original image, based on a low-resolution images of the original being emedded into the image through watermarking.

## Information Hiding

**Description:** Information hiding utilizes the multimedia data as a media to transmit information, which can be the objective information (as used in military) or value-added information (such as the personal data of a picture). The considerations and difficulties in information hiding are similar to the semi-fragile watermark: robustness, large amount of data, and imperceptibility.

**My prior works:** I developed theories to predict and utilize theoretical capacity of information hiding based on the Human Vision Modeling and the Information Theory.

## Computational Social Science

*Computational social science* is to study Human/Social Attributes and Dynamics through observable data using multimodality signal understanding techniques. *Computational social science* aims at (1) modeling and predicting human behavior via computer, and (2) objectively interpreting observations for social science researchers. We shall work closely with social scientists as well as biomedical scientists to achieve these goals.

In ancient philosophy, there was no difference between studying mathematics, history, poetry or politics. Aristotle studies planetary motion and poetry with the same methods, and Plato mixes geometrical proofs with his demonstration on the state of intrinsic knowledge. Only when the mathematical proof methodology arises over centuries, there becomes a perceived difference between natural scientific fields and humanities fields. Humanities fields suffer from the difficulty of objective and repeatable experiments that arouses a longstanding argument that whether "social science" belongs scientific disciplines. However, similar perceptions can change. For instance, biology -- before Darwin's articles, was resistant to mathematical proofs and models. Its research methodology stayed at descriptive form before Darwin's The Theory of Nature Selection.

Video understanding is an important media to interpret human behavior. Sociologist would like to see more subjective perceptions being pinned down by more objective measurements. In a Pedagogy study, for instance, researchers would like to understand which teaching method can improve the interaction of teacher-students or how to effectively teach minority students. Usually, they record classroom videos for 3 months to a year and watch them recursively to support their hypotheses. Another example is, at political science study, researchers would like to find out how public consensus is formed through the interaction of people in a meeting. Usually, they need to observe large amount of videos to answer questions like: (1) Will highly educated people show their opinions more than those with lower education?, (2) Will people with lower education modify their thoughts according to other people's opinions more easily than highly educated ones?, (3) Will the final meeting result/conclusion consistent with the opinion of people who dominate the meeting?, and (4) To what level the meeting conclusion will be driven by the shown-up emotion? In above cases, visual understanding techniques can detect emotions and human interaction types, speech recognition and text understanding can detect the educational level of participants and the influence chains of attendees' opinions, and face recognition techniques can identify people. These techniques shall objectively convert high volume videos into semantic indices that will be easily transcribed, searched and further interpreted by researchers.

Using mostly text-based data, such as emails, web access logs, instant messages, publications, etc, is another important way to understand humanity. Krackhardt showed that companies with strong informal networks perform five or six times better than those with weak networks, especially on the long-term performance. Friend and advice networks drive enterprise operations in a way that, if the real organization structure does not match the informal networks, then a company tends to fail. Since Max Weber first studied modern bureaucracy structures in the 1920s, decades of related social scientific researches have been mainly relying on questionnaires and interviews to understand individuals' thoughts and behaviors. However, data collection is time consuming and seldom provides timely, continuous, and dynamic information. With multimodality understanding technologies, we can automatically detect the informal network to suggest structure change for more effective organizational management.

Understanding human behavior can help improving our life quality. As the percentage of the elder population continues to rise, advanced health care system has been an active subject of many research projects. For health care applications, there are often critical needs on recognizing a person's physical location, condition, and activity. Various sensors can be deployed to acquire multimodality data for recognizing a user's contextual information. With the knowledge of a user's contextual information, a personal assistant/recommender or warning system can be developed to recommend activities for improving long-term health conditions, raise alarms for emergency situations, and monitor long-term health changes via early-warning detection.

In addition to providing objective scalable observations to social scientists, we also aim to develop advanced learning machines to model and predict human and society behaviors. For instance, we can allow machines use supervised learning to learn from the experience of psychologists towards predicting the marriage status of couples through interview videos. Text-based analysis can also be used in analyzing the authenticity of arts, e.g., literature, paintings, scientific publications, based on its style, e.g., the author of articles, paintings, etc.

Understanding human and society behavior is an important emerging research trend. We call this research thread as *Computational social science*. We see multidisciplinary research is a must towards its success, and computer scientists definitely play a critical role. Recently, we found out that NSF identified *Human and Society Dynamics* as one of its five priorities, among nanoscience technology, biocomplexity in environments, mathematical science, and cyberinfrastructure. We are all human, living in societies. We, thus, consider this as a novel field that is worth significant investigation.

***My work before 2006:*** Since 2001, we have conducted research to automatically learn generic video concepts and have since performed best in the annual NIST benchmarking. In the last two years, we have investigated various human and society modeling methodologies and proposed novel dynamic graph-based algorithms to model human expertise, interests, and social networks. Recently, we have applied low-cost video camera, audio, heartbeat and passive infrared sensors to automatically inference sleep condition, in order to better understand night time activities that shall have affected subjects' health and day-time performance. I have been doing researches on multimedia signal processing field since 1991. I believe I am a rare researcher who has abundant experience in conducting world-class researches at various practical multimodality recognition works. I was also well-trained with several social science fields in my undergraduate study, and actively participated the democratic development in Taiwan from late 80s to early 90s. These shall be my advantages of leading these highly integrated multidisciplinary researches. Overall, I authored or co-authored 14 papers specifically in the area of computational social science.

***Research projects (by 2005):***

- ***Integrated System for Human Behavior Indexing in Videos***
- ***Dynamic Graphic Modeling and Matching of Human Attributes through Multimodality Understanding***
- ***Dynamic Societal Evolution through Multimodality Understanding***
- ***Human Activity Recognition through Multimodality Sensor Networks***
- ***Multimodality Signal Processing for Healthcare Applications***