

RESUME

Chun-Chieh Yang, Ph.D.

CONTACT INFORMATION

Environmental Microbial and Food Safety Laboratory
Building 303, BARC-East, Powder Mill Road
Beltsville, MD 20705-2350

Email: chun-chieh.yang@ars.usda.gov

Tel: (301) 504-8450 extension 232

EXPERTISE

- Engineering
 - Automation
 - System management, integration, and control
 - Food safety and defense
 - Online food inspection
 - Precision farming
 - Water management
 - Agricultural machinery
 - Geographic information system

- Computer modeling
 - Artificial neural network
 - Fuzzy logic
 - Decision tree
 - Multivariate adaptive regression splines
 - Other data mining

- Machine vision
 - Image processing
 - Image recognition, classification, and differentiation
 - Line scan
 - Online imaging
 - Image spectrograph

- Remote sensing
 - Hyperspectral imaging
 - Multispectral imaging

- Computer programming
 - MATLAB

- LabVIEW
- Fortran
- C

PROFESSIONAL EXPERIENCE

- 2003 – present: Agricultural Engineer/Research Associate, Environmental Microbial and Food Safety Laboratory (formerly the Food Safety Laboratory until 2008), Agricultural Research Service, United States Department of Agriculture.
 - **Accomplishments:**
 1. Developed an online high speed line-scan Raman imaging system for safety inspection of fresh produce.
 2. Commercialized an automated poultry carcass inspection system for Stork Food and Dairy Systems, Inc.

- 2003 – 2008: Visiting Scientist, Food Safety Laboratory (formerly the Instrumentation and Sensing Laboratory until 2007), Agricultural Research Service, United States Department of Agriculture. Joint position as a Postdoctoral Scholar, Department of Biosystems and Agricultural Engineering, University of Kentucky.
 - **Accomplishments:**
 1. Developed an online high speed line-scan imaging system for safety inspection of poultry.
 2. Commercialized an automated poultry carcass inspection system for Stork Food and Dairy Systems, Inc.
 3. Developed hyperspectral / multispectral image processing techniques for food safety inspection of chicken carcasses.
 4. Integrated artificial intelligence algorithms (based on neural networks, decision trees, and fuzzy logic) into a machine vision system to implement image processing techniques for an automated food safety inspection system on chicken processing lines.
 5. Analyzed hyperspectral data and determined essential multispectral image features by which automated differentiation of wholesome and unwholesome chickens could be performed.
 6. Analyzed visible/near-infrared reflectance spectroscopy data for chicken meat and developed neural network classification models to differentiate wholesome and unwholesome chickens.
 7. Assisted in testing and determination of operation parameters for the development of a hyperspectral line-scan fluorescence imaging system for online safety inspection of apples.

- 2004 – 2005: Artificial Neural Network Model for the Prediction of Nitrate Concentrations in the Phreatic Aquifer of Esposende and Vila do Conde, project ref. POCTI/MGS/47182/2002, the Science and Technology Foundation of the Portuguese Science and Superior Education Ministry, Portugal.

- 2001: Water Consumption Modeling in Northern China, Canadian International Development Agency (CIDA) 3x3 Project, involving four Canadian universities (McGill University, University of Toronto, University of British Columbia and University of Montreal) and three Chinese universities (Beijing University, Chinghua University and Nankai University), funded by Canadian International Development Agency (CIDA), Canada.
- 2001: Efficient Planning of Montreal Urban Forests by Means of a Decision Making Computerized System Project, Canada.
- 2000 – 2002: Postdoctoral Fellow, Department of Agricultural and Biosystems Engineering, McGill University.
 - **Accomplishments:**
 1. Successfully adapted remote sensing methods of hyperspectral imaging to develop hyperspectral imaging methodology and analysis techniques for weed detection in precision agriculture.
 2. Developed computer models based on artificial intelligence methods (neural networks, decision trees, fuzzy logic) for weed differentiation from crops in precision agriculture.
 3. Integrated hyperspectral imaging methodology and analysis techniques with computer models to successfully develop a complete weed management system suitable for site-specific adaptation.
 4. Developed computer models using artificial intelligence based on neural networks for subsurface drainage/subirrigation water management systems.
 5. Developed computer models using neural networks, decision trees, fuzzy logic, and multivariate adaptive regression spline for higher efficiency in agrochemical management.
 6. Provided technical expertise as part of an international team of university researchers conducting government-sponsored development of a geographic information system to improve water resource management in urban areas. Guided data collection and computer modeling used in GIS development.
 7. Collaborated in project proposals successfully submitted for various grant applications.
- 2000: Guest Speaker, Soil and Water Quality Management, Department of Natural Resource Sciences, McGill University.
- 2000: Instructor, Structured Computer Programming, Department of Agricultural and Biosystems Engineering, McGill University.
- 1997 – 1998: Teaching Assistant, Geographic Information System for Biosystems Management, Department of Agricultural and Biosystems Engineering, McGill University.
- 1996 – 1998: Teaching Assistant, Structured Computer Programming, Department of

Agricultural and Biosystems Engineering, McGill University.

EDUCATION

- Ph.D. 1995 – 2000. Department of Agricultural and Biosystems Engineering (was renamed Department of Bioresource Engineering), McGill University, Canada.
- M.Sc. 1993 – 1995. Department of Agricultural and Biosystems Engineering (was renamed Department of Bioresource Engineering), McGill University, Canada.
- B.Sc. 1986 – 1990. Department of Agricultural Machinery Engineering (was renamed Department of Bio-Industrial Mechatronics Engineering), National Taiwan University, Taiwan, R.O.C.

PROFESSIONAL ORGANIZATION MEMBERSHIP AND ACTIVITIES

- Member of the American Society of Agricultural and Biological Engineers (ASABE). 1995 – present
 - Committee Member of ASABE Information and Electrical Technologies Division, IET-312 Machine Vision. 2004 – present
 - Chair, ASABE Information and Electrical Technologies Division, IET-312 Machine Vision. 2008 – 2009
 - Vice Chair, ASABE Information and Electrical Technologies Division, IET-312 Machine Vision. 2007 – 2008
 - Secretary, ASABE Information and Electrical Technologies Division, IET-312 Machine Vision. 2006 – 2007

AWARDS AND HONORS

- Recognition for the "Electronics in Agriculture" Top-15 Achievement as part of "100 Years of Innovation" for ASABE Centennial Anniversary at the ASABE 2007 International Meeting in Minneapolis, MN, June 17-20, which highlighted the high-speed poultry inspection system developed by the Instrumentation and Sensing Laboratory (was renamed Food Safety Laboratory).
 - International-wide competition
- Honorable Mention, BARC Poster Day, Beltsville Agriculture Research Center, Beltsville Area, USDA-ARS. 2006
 - Area-wide competition
- Extra Effort Award, USDA-ARS. 2004
 - For the support provided to in-plant testing of the ISL commercial prototype visible/near-infrared automated poultry inspection system at Tyson Foods chicken processing facility in New Holland, PA

- Second Prize, BARC Poster Day, Beltsville Agriculture Research Center, Beltsville Area, USDA-ARS. 2004
 - Area-wide competition
- Formation de chercheurs et l'aide à la recherche (FCAR) (Recipient of Funds for the training of researchers and the assistance with research), Quebec, Canada. 1997-1998
 - Nationwide competition
- Canadian Water Resources Association Graduate Scholarship, Canada. 1996
 - Nationwide competition

PROFESSIONAL SERVICE

- Associate Editor for the ASABE Publications, IET Division. 2007 - present
- Manuscript reviewer for the following technical journals (listed alphabetically), 1999 – present:
 1. Biosystems Engineering
 2. Canadian Water Resources Journal
 3. Canadian Biosystems Engineering
 4. Computers and Electronics in Agriculture
 5. Hydrological Sciences Journal
 6. Journal of the American Water Resources Association
 7. Sensing and Instrumentation for Food Quality and Safety
 8. Soil Science Society of America Journal
 9. Transactions of the ASAE
 10. Weed Research
 11. Natural Resource Modeling

PATENT UNDER REVIEW

1. Chao, K., Y.-R. Chen, M. S. Kim, D. E. Chan and **C.-C. Yang**. 2007. Method and System for Wholesomeness Inspection of Freshly Slaughtered Chickens on a Processing Line.

REFEREED PUBLICATIONS

1. **Yang, C.-C.**, K. Chao and M. S. Kim. 2009. Machine vision system for online inspection of freshly slaughtered chickens. *Sensing and Instrumentation for Food Quality and Safety*, 3(1): 70-80.
2. Chao, K., **C.-C. Yang**, M. S. Kim and D. E. Chan. 2008. High throughput spectral imaging system for wholesomeness inspection of chicken. *Applied Engineering in Agriculture* 24(4): 475-485.

3. Chao, K., X. Nou, Y. Liu, M. S. Kim, D. E. Chan, **C.-C. Yang**, J. R. Patel and M. Sharma. 2008. Detection of fecal/ingesta contaminants on poultry processing equipment surfaces by visible and near-infrared reflectance spectroscopy. *Applied Engineering in Agriculture*, 24(11): 49-55.
4. Kim, M. S., Y.-R. Chen, B. Cho, A. M. Lefcourt, K. Chao and **C.-C. Yang**. 2008. Online hyperspectral line-scan fluorescence imaging for safety inspection of apples. *Acta Horticulturae*, 768(1): 385-390.
5. Chao, K., **C.-C. Yang**, Y.-R. Chen, M. S. Kim and D. E. Chan. 2007. Hyperspectral-multispectral line-scan imaging system for automated poultry carcass inspection applications for food safety. *Poultry Science*, 86(11): 2450-2460.
6. Kim, M. S., Y.-R. Chen, B. K. Cho, K. Chao, **C.-C. Yang**, A. M. Lefcourt and D. E. Chan. 2007. Hyperspectral reflectance and fluorescence line-scan imaging for online defect and fecal contamination inspection of apples. *Sensing and Instrumentation for Food Quality and Safety*, 1(3): 151-159.
7. **Yang, C.-C.**, S. O. Prasher, S. Wang, S. H. Kim, C. S. Tan, C. Drury and R. M. Patel. 2007. Simulation of nitrate-n pollution in southern Ontario with DRAINMOD-N. *Agricultural Water Management*, 87(3): 299-306.
8. Chao, K., **C.-C. Yang**, Y.-R. Chen, M. S. Kim and D. E. Chan. 2007. Fast line-scan imaging system for broiler carcass inspection. *Sensing and Instrumentation for Food Quality and Safety*, 1(2): 62-71.
9. Chao, K., Y.-R. Chen, F. Ding, **C.-C. Yang** and D.E. Chan. 2007. Development of two-band color-mixing technique for identification of broiler carcass conditions. *Journal of Food Engineering*, 80(1): 276-283.
10. Wang, S., S. O. Prasher, R. M. Patel, **C.-C. Yang**, S. H. Kim, A. Madani, P. M. Macdonald and S. D. Robertson. 2006. Fate and transport of nitrogen compounds in a cold region soil using DRAINMOD. *Computers and Electronics in Agriculture*, 53(2): 113-121.
11. **Yang, C.-C.**, K. Chao, Y.-R. Chen, M. S. Kim and D. E. Chan. 2006. Development of Fuzzy Logic-based Differentiation Algorithm and Fast Line-Scan Imaging System for Chicken Inspection. *Biosystems Engineering*, 95(4): 483-496.
12. Liu, Y., K. Chao, Y.-R. Chen, M. S. Kim, X. Nou, D. E. Chan and **C.-C. Yang**. 2006. Determination of key wavelengths in the detection of feces / ingesta contaminants for sanitation verification at slaughter plants from visible and near infrared spectroscopy. *Journal of Near Infrared Spectroscopy*, 14(5): 325-331.
13. **Yang, C.-C.**, K. Chao, Y. R. Chen, M. S. Kim and H. L. Early. 2006. Simple region of

interest analysis for systemically diseased chicken identification using multispectral imaging. *Transactions of the ASAE*, 49(1): 245-257.

14. **Yang, C.-C.**, K. Chao, Y. R. Chen and H. L. Early. 2005. Systemically diseased chicken identification using multispectral images and region of interest analysis. *Computers and Electronics in Agriculture*, 49(2): 255-271.
15. **Yang, C.-C.**, K. Chao and Y. R. Chen. 2005. Development of multispectral imaging processing algorithms for identification of wholesome, septicemia, and inflammatory process chickens. *Journal of Food Engineering*, 69(2): 225-234.
16. **Yang, C.-C.**, S. O. Prasher, R. Lacroix and S. H. Kim. 2004. Application of multivariate adaptive regression splines (MARS) to simulate soil temperature. *Transactions of the ASAE*, 47(3): 881-887.
17. **Yang, C.-C.**, S. O. Prasher and P. K. Goel. 2004. Differentiation of crop and weeds by decision-tree analysis of multi-spectral data. *Transactions of the ASAE*, 47(3): 873-879.
18. **Yang, C.-C.**, S. O. Prasher, R. Lacroix and S. H. Kim. 2003. A multivariate adaptive regression splines model for simulation of pesticide transport in soils. *Biosystems Engineering*, 86(1): 9-15.
19. **Yang, C.-C.**, S. O. Prasher, P. Enright, C. Madramootoo, M. Burgess, P. K. Goel and I. Callum. 2003. Application of decision tree technology for image classification using remote sensing data. *Agricultural Systems*, 76(3): 1101-1117.
20. **Yang, C.-C.**, S. O. Prasher, J.-A. Landry and H. S. Ramaswamy. 2003. Development of a herbicide application map using artificial neural networks and fuzzy logic. *Agricultural Systems*, 76(2): 561-574.
21. **Yang, C.-C.**, S. O. Prasher and J.-A. Landry. 2003. Development of an image processing system and a fuzzy controller for site-specific herbicide applications. *Precision Agriculture*, 4(1): 5-18.
22. **Yang, C.-C.**, S. O. Prasher and J.-A. Landry. 2002. Weed recognition in corn fields using back-propagation neural network models. *Canadian Biosystems Engineering*, 44:715-722.
23. **Yang, C.-C.**, S. O. Prasher, J. Whalen and P. K. Goel. 2002. Use of hyperspectral imagery for identification of different fertilization methods with decision tree technology. *Biosystems Engineering*, 83(3): 291-298.
24. **Yang, C.-C.**, S. O. Prasher, J.-A. Landry and H. S. Ramaswamy. 2002. Development of neural networks for weed recognition in corn fields. *Transactions of the ASAE*, 45(3): 859-864.

25. **Yang, C.-C.**, S. O. Prasher, J.-A. Landry and R. Kok. 2002. The development of image processing and weed localization algorithms for precision farming. *Biosystems Engineering*, 81(2): 137-146.
26. **Yang, C.-C.**, S. O. Prasher, J.-A. Landry, J. Perret and H. S. Ramaswamy. 2000. Recognition of weeds with image processing and their use with fuzzy logic for precision farming. *Canadian Agricultural Engineering*, 42(4): 195-200.
27. **Yang, C.-C.**, S. O. Prasher, J.-A. Landry, H. S. Ramaswamy and A. DiTommaso. 2000. Application of artificial neural networks in image recognition and classification of crop and weeds. *Canadian Agricultural Engineering*, 42(3): 147-152.
28. **Yang, C.-C.**, C. S. Tan and S. O. Prasher. 2000. Artificial neural networks for subsurface drainage and subirrigation systems in Ontario, Canada. *Journal of the American Water Resources Association*, 36(3): 609-618.
29. **Yang, C.-C.**, S. O. Prasher and C. S. Tan. 1999. An artificial neural network model for water table management systems. *Canadian Water Resources Journal*, 24(1): 25-33.
30. **Yang, C.-C.**, R. Lacroix, and S. O. Prasher. 1998. The use of back-propagation neural networks for the simulation and analyses of time-series data in subsurface drainage systems. *Transactions of the ASAE*, 41(4): 1181-1187.
31. **Yang, C.-C.**, S. O. Prasher, R. Lacroix and A. Madani. 1997. Application of Artificial neural networks in subsurface drainage system design. *Canadian Water Resources Journal*, 22(1): 1-12.
32. **Yang, C.-C.**, S. O. Prasher, R. Lacroix, S. Sreekanth, A. Madani and L. Masse. 1997. Artificial neural network model for subsurface-drained farmlands. *Journal of Irrigation and Drainage Engineering*, 123(4): 285-292.
33. **Yang, C.-C.**, S. O. Prasher and G. R. Mehuys. 1997. An artificial neural network to estimate soil temperature. *Canadian Journal of Soil Science*, 77(3): 421-429.
34. **Yang, C.-C.**, S. O. Prasher, G. R. Mehuys and N. K. Patni. 1997. Application of artificial neural networks for simulation of soil temperature. *Transactions of the ASAE*, 40(3): 649-656.
35. **Yang, C.-C.**, S. O. Prasher, S. Sreekanth, N. K. Patni and L. Masse. 1997. An artificial neural network model for simulating pesticide concentrations in soil. *Transactions of the ASAE*, 40(5): 1285-1294.
36. Sreekanth, S., S. O. Prasher and **C.-C. Yang**. 1997. Importance of choice of input parameters in artificial neural network simulation of water-table depths. *Canadian Water*

Resource Journal, 22(2): 111-124.

37. **Yang, C.-C.**, S. O. Prasher and R. Lacroix. 1996. Applications of artificial neural networks to simulate water-table depths under subirrigation. *Canadian Water Resources Journal*, 21(1): 27-44.
38. **Yang, C.-C.**, S. O. Prasher and R. Lacroix. 1996. Applications of artificial neural networks to land drainage engineering. *Transactions of the ASAE*, 39(2): 525-533.

REFEREED PUBLICATIONS UNDER REVIEW

1. **Yang, C.-C.**, D. E. Chan, K. Chao, Y.-R. Chen and M. S. Kim. 2007. Development and in-plant testing of line-scan machine vision system for online poultry carcass inspection. *The Journal of Electronic Imaging*.

CONFERENCE PROCEEDINGS AND TECHNICAL REPORTS

1. **Yang, C.-C.**, K. Chao, M. S. Kim, D. E. Chan and Y. R. Chen. 2008. Multispectral imaging system and differentiation algorithm for online inspection of poultry carcasses. *The American Society of Agricultural and Biological Engineers (ASABE), 2008 international meeting*, paper no. 08-3925.
2. **Yang, C.-C.**, K. Chao, M. S. Kim, D. E. Chan and Y. R. Chen. 2008. Online machine vision system for inspection of poultry carcasses. *The American Society of Agricultural and Biological Engineers (ASABE), 2008 international meeting*, paper no. 08-3926.
3. Chao, K., **C.-C. Yang** and M. S. Kim. 2008. High throughput spectral imaging system for broiler carcass inspection. *The American Society of Agricultural and Biological Engineers (ASABE), 2008 international meeting*, paper no. 08-3818.
4. **Yang, C.-C.**, K. Chao, M. S. Kim and D. E. Chan. 2008. Machine vision system for automatic online inspection of freshly slaughtered chickens. *Food Processing Automation Conference*, Providence, RI, USA, June 28-29, 2008. The American Society of Agricultural and Biological Engineers (ASABE).
5. **Yang, C.-C.**, K. Chao and Y. R. Chen. 2007. Online application of machine vision system for differentiation of wholesome and diseased poultry carcasses. *The American Society of Agricultural and Biological Engineers (ASABE), 2007 international meeting*, paper no. 07-3084.
6. Chen, Y.-R., B. K. Cho, C.-C. Yang, K. Chao and A.M. Lefcourt. 2007. Online line-scan hyperspectral imaging for postharvest safety and quality inspection of apples. *The American Society of Agricultural and Biological Engineers (ASABE), 2007 international meeting*, paper no. 07-3026.

7. Chao, K., **C.-C. Yang**, Y.-R. Chen, M. S. Kim and D. E. Chan. 2007. Fast-line scan imaging system for chicken carcass inspection. *The American Society of Agricultural and Biological Engineers (ASABE), 2007 international meeting*, paper no. 07-3032.
8. **Yang, C.-C.**, D. E. Chan, K. Chao, Y. R. Chen and M. S. Kim. 2006. Development of online line-scan imaging system for chicken inspection and differentiation. *Optical Sensors and Sensing Systems for natural Resources and Food Safety and Quality, Proceedings of SPIE, Volume 6381*, p. 63810Y-1-63810Y-10. OpticsEast 2006, Boston, MA, USA, October 2-4, 2006. The International Society for Optical Engineering.
9. Chao, K., **C.-C. Yang**, Y. R. Chen, D. E. Chan and M. S. Kim. 2006. Poultry carcass inspection by a fast line-scan imaging system: results from in-plant testing. *Optical Sensors and Sensing Systems for natural Resources and Food Safety and Quality, Proceedings of SPIE, Volume 6381*, p. 63810V-1-63810V-11. OpticsEast 2006, Boston, MA, USA, October 2-4, 2006. The International Society for Optical Engineering.
10. Liu, Y., K. Chao, Y. R. Chen, M. S. Kim, X. Nou, D. E. Chan and **C.-C. Yang**. 2006. Detection of fecal / ingesta contaminants at slaughter plants from a number of characteristic visible and near infrared bands. *Optical Sensors and Sensing Systems for natural Resources and Food Safety and Quality, Proceedings of SPIE, Volume 6381*, p. 63810U-1-63810U-9. OpticsEast 2006, Boston, MA, USA, October 2-4, 2006. The International Society for Optical Engineering.
11. Kim, M. S., B.-K. Cho, **C.-C. Yang**, K. Chao, A. M. Lefcourt and Y. R. Chen. 2006. Hyperspectral reflectance and fluorescence line-scan imaging system for online detection of fecal contamination on apples. *Optical Sensors and Sensing Systems for natural Resources and Food Safety and Quality, Proceedings of SPIE, Volume 6381*, p. 63810P-1-63810P-8. OpticsEast 2006, Boston, MA, USA, October 2-4, 2006. The International Society for Optical Engineering.
12. **Yang, C.-C.**, K. Chao, Y.-R. Chen, M. S. Kim and D. E. Chan. 2006. Fuzzy logic-based differentiation imaging system for systemically diseased chicken detection. *The American Society of Agricultural and Biological Engineers (ASABE), 2006 international meeting*, paper no. 06-3076.
13. **Yang, C.-C.**, K. Chao, Y.-R. Chen, M. S. Kim, and D. E. Chan. 2006. Fast line-scan imaging system using fuzzy logic-based differentiation algorithm for chicken inspection. *Institute of Food Technologists (IFT), 2006 annual meeting and food expo*, presentation no. 078E-09.
14. **Yang, C.-C.**, K. Chao, Y. R. Chen, and M. S. Kim. 2006. Line-Scan Machine Vision System for Online Poultry Carcass Inspection. April 26, 2004, *BARC Poster Day*. Beltsville Agriculture Research Center, USDA-ARS.
15. **Yang, C.-C.**, K. Chao, Y. R. Chen and M. S. Kim. 2005. Development of fast line

scanning imaging algorithm for diseased chicken detection. *Optical Sensors and Sensing Systems for natural Resources and Food Safety and Quality, Proceedings of SPIE, Volume 5996*, p. 59960C-1-59960C-12. OpticsEast 2005, Boston, MA, USA, October 22-23, 2005. The International Society for Optical Engineering.

16. **Yang, C.-C.**, S. O. Prasher and J. Whalen. 2005. Application of hyperspectral imagery and prediction algorithms to precision agriculture. *The American Society of Agricultural Engineers (ASAE), 2005 international meeting*, paper no. 05-1062.
17. **Yang, C.-C.**, K. Chao, Y. R. Chen and H. L. Early. 2005. Application of multispectral imaging for wholesome and systemically diseased chickens. *The American Society of Agricultural Engineers (ASAE), 2005 international meeting*, paper no. 05-3125.
18. Chao, K., Y. R. Chen, **C.-C. Yang**, and D. E. Chan. 2005. Characterizing spectra variations for cleaning and sanitation issues in poultry processing plant *The American Society of Agricultural Engineers (ASAE), 2005 international meeting*, paper no. 05-3035.
19. Abreu, A. S., S. O. Prasher and **C.-C. Yang**. 2005. Development of REDENITRA, an artificial neural network clone of RZWQM model, for the simulation of nitrate-N leaching. *The American Society of Agricultural Engineers (ASAE), 2005 international meeting*, paper no. 05-2112.
20. Abreu, A. S., S. O. Prasher and **C.-C. Yang**. 2005. REDENITRA, a backpropagation artificial neural network (BANN) model, clone of RZWQM, that predicts the amount of nitrate-N leaching in agricultural systems. *EGU General Assembly 2005*. Vienna, Austria.
21. **Yang, C.-C.**, K. Chao, Y. R. Chen and H. L. Early. 2004. Systemically diseased chicken identification using multispectral images and region of interest analysis. *Nondestructive Sensing for Food Safety, Quality, and Natural Resources, Proceedings of SPIE, Volume 5587*, p. 121-132. OpticsEast 2004, Philadelphia, PA, USA, October 26-27, 2004. The International Society for Optical Engineering.
22. **Yang, C.-C.**, K. Chao and Y. R. Chen. 2004. Development of multispectral imaging processing algorithms for Identification of Wholesome, Septicemic, and Inflammatory Process Chickens. April 29, 2004, *BARC Poster Day*. Beltsville Agriculture Research Center, USDA-ARS.
23. **Yang, C.-C.**, K. Chao, Y. R. Chen and M. S. Kim. 2004. Application of multispectral imaging for identification of wholesome and systemically diseased chicken. *The American Society of Agricultural Engineers (ASAE), 2004 international meeting*, paper no. 04-3034.
24. **Yang, C.-C.**, K. Chao and Y. R. Chen. 2003. Development of multispectral imaging processing algorithms for food safety inspection on poultry carcasses. *The American*

- Society of Agricultural Engineers (ASAE), 2003 international meeting, paper no. 03-3054.*
25. **Yang, C.-C.**, S. O. Prasher and J. Whalen. 2003. Neural network models for crop yield classification using hyperspectral imagery. *The American Society of Agricultural Engineers (ASAE), 2003 international meeting, paper no. 03-1112.*
 26. Karimi, Y., S. O. Prasher, H. McNarin, R. B. Bonnell, P. Dutilleul, P. K. Goel, **C.-C. Yang** and Y. Uno. 2003. Hyperspectral remote sensing for discriminating water and nitrogen stresses in a corn field. *The American Society of Agricultural Engineers (ASAE), 2003 international meeting, paper no. 03-1111.*
 27. **Yang, C.-C.** S. O. Prasher, S. Wang, S. H. Kim. C. S. Tan and C. Drury. 2002. Simulation of nitrate-N pollution in southern Ontario with DRAINMOD-N. *Northeast Agricultural and Biological Engineering Conference (NABEC), 2002 annual meeting, paper no. 02-028.*
 28. **Yang, C.-C.**, S. O. Prasher and P. K. Goel. 2002. Differentiation of crop and weeds by decision tree analysis of multi-spectral data. *The American Society of Agricultural Engineers (ASAE), 2002 international meeting, paper no. 02-1080.*
 29. **Yang, C.-C.**, S. O. Prasher and J. Whalen. 2002. Prediction of yields for corn and soybean with hyperspectral imagery. *The American Society of Agricultural Engineers (ASAE), 2002 international meeting, paper no. 02-3139.*
 30. Wang, S., S. O. Prasher, **C.-C. Yang**, S. H. Kim, A. Madani, P. M. MacDonald and S. D. Robertson. 2002. Field validation of a mathematical model to estimate nitrate-nitrogen pollution from subsurface drained farmlands. *The American Society of Agricultural Engineers (ASAE), 2002 international meeting, paper no. 02-2039.*
 31. Jutras, P., S. O. Prasher, **C.-C. Yang** and C. Hamel. 2002. Urban tree growth modeling with artificial neural network. *Proceedings of the 2002 International Joint Conference on Neural Networks, IJCNN'02, Honolulu, Hawaii, USA, May 12-17, 2002: 1385-1389.*
 32. **Yang, C.-C.**, S. O. Prasher, J. Whalen and P. K. Goel. 2001. Application of data mining technology for hyperspectral imagery classification in agricultural fields. *The American Society of Agricultural Engineers (ASAE), 2001 international meeting, paper no. 01-3116.*
 33. Goel, P. K., S. O. Prasher, R. M. Patel, J. A. Landry, A. A. Viau and **C.-C. Yang**. 2001. Weed and nitrogen stress detection in corn using airborne hyperspectral remote sensing. *The American Society of Agricultural Engineers (ASAE), 2001 international meeting, paper no. 01-1199.*
 34. Salehi, F., S. O. Prasher, S. Amin, A. Madani, S. J. Jebelli, H. S. Ramaswamy, C. Tan, C.

- F. Drury and **C.-C. Yang**. 2001. Prediction of annual nitrate-N losses in drain outflows with artificial neural networks. *The American Society of Agricultural Engineers (ASAE), 2001 international meeting*, paper no. 01-3064.
35. **Yang, C.-C.**, S. O. Prasher, P. Enright, C. Madramootoo, M. Burgess, P. K. Goel and I. Callum. 2001. Application of data mining technology for image classification using remote sensing data. *The Canadian Society of Agricultural Engineering (CSAE), 2001 annual meeting with the Northeast Agricultural and Biological Engineering Conference (NABEC) and the Agricultural Institute of Canada (AIC)*, paper no. 01-611.
36. **Yang, C.-C.**, S. O. Prasher, P. K. Goel and R. Patel. 2001. Application of data mining for image classification in remote sensing. *Journée d'information scientifique et technique en génie agroalimentaire*, Saint-Hyacinthe, QC, Canada, March 21, 2001, 33-40.
37. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 2000. Development of a weed management system for precision farming. *Northeast Agricultural and Biological Engineering Conference (NABEC), 2000 annual meeting*, paper no. 2031.
38. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 2000. Applications of artificial neural networks to plant recognition in the field. *The American Society of Agricultural Engineers (ASAE), 2000 international meeting*, paper no. 00-3054.
39. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1999. Development of weed maps in corn fields for precision farming. *The American Society of Agricultural Engineers (ASAE), 1999 international meeting*, paper no. 99-3044.
40. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1999. Weed recognition in precision farming. *The American Society of Agricultural Engineers (ASAE), 1999 international meeting*, paper no. 99-3115.
41. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1999. Use of artificial neural networks to recognize weeds in a corn field. *Journée d'information scientifique et technique en génie agroalimentaire*, Saint-Hyacinthe, QC, Canada, March 3, 1999, 60-65.
42. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1998. Application of artificial neural networks to image recognition in precision farming. *The American Society of Agricultural Engineers (ASAE), 1998 international meeting*, paper no. 98-3039.
43. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1998. Application of image processing and weed recognition in precision farming. *Northeast Agricultural and Biological Engineering Conference (NABEC), 1998 annual meeting*, paper no. 9825.
44. **Yang, C.-C.**, S. O. Prasher and C. S. Tan. 1998. An artificial neural network model for water table management system. *Drainage in the 21st Century: Food Production and the Environment. Proceedings of the 7th Annual Drainage Symposium*, Orlando, FL, USA,

March 8-10, 1998, p. 250-257.

45. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1997. Application of machine vision and artificial neural networks in precision farming. *The American Society of Agricultural Engineers (ASAE), 1997 international meeting*, paper no. 97-3107.
46. **Yang, C.-C.** and S. O. Prasher. 1997. Application of precision farming. *CSAE Conference Proceedings*, volume A, Sherbrooke, QC, Canada, 1997. p. 71-80. Canadian Society of Agricultural Engineering.
47. **Yang, C.-C.**, S. O. Prasher and J. A. Landry. 1997. The use of information technologies in precision farming. *CSAE Conference Proceedings*, volume A, Sherbrooke, QC, Canada, 1997. p. 562-571. Canadian Society of Agricultural Engineering.
48. **Yang, C.-C.**, S. O. Prasher and S. Sreekanth. 1996. An artificial neural network model for pesticide fate and transport. *The American Society of Agricultural Engineers (ASAE), 1996 international meeting*, paper no. 96-2025.
49. **Yang, C.-C.**, S. O. Prasher, R. Lacroix, S. Sreekanth, N. K. Patni and L. Masse. 1996. An artificial neural network model for the simulation of water-table depths and drain outflows. *Proceedings of the 49th Annual Conference of the Canadian Water Resources Association*, Quebec City, June 26-28, 1996: 225-239.
50. **Yang, C.-C.**, R. Lacroix, and S. O. Prasher. 1996. The use of back-propagation in neural networks for the simulation and analyses of time-series data in subsurface drainage systems. *Proceedings of Computers in Agriculture*, Cancun, Mexico, June 10-14, 1996: 941-949.
51. **Yang, C.-C.**, S. O. Prasher and R. Lacroix. 1996. Application of artificial neural networks in subsurface drainage system design. *Proceedings of Computers in Agriculture*, Cancun, Mexico, June 10-14, 1996: 932-940.
52. **Yang, C.-C.**, S. O. Prasher and R. Lacroix. 1995. Applications of artificial neural networks to land drainage engineering. *The Canadian Society of Agricultural Engineering (CSAE), 1995 annual meeting*, paper no. 95-610.