

## Valliappa LAKSHMANAN

### Work Address

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### Summary

- Expertise in machine intelligence R&D for meteorological applications.
- Expertise designing and developing large-scale software systems.
- Excellent skills in communicating technical and non-technical material to diverse audiences.

### Employment History

CIMMS - OU & NSSL Norman OK  
07/95–Present

I am a Research Scientist, the technical lead on several software projects and research groups. I also develop automated real-time pattern recognition algorithms and visualization techniques for weather phenomena.

RESEARCH INSTITUTE, CLEVELAND CLINIC FOUNDATION Cleveland OH  
04/94–04/95

Developed an image processing and visualization technique to automatically identify 2D cross-sections of the mitral valve in ultrasound images and to render animated 3D views fast enough to view interactively.

THE OHIO STATE UNIVERSITY MEDICAL SCHOOL Columbus OH  
02/94–06/95

Developed a tutorial program to aid medical students in the study of anatomy. This involved image processing and visualization of MRI images and CT scans of cadavers.

### Education

THE UNIVERSITY OF OKLAHOMA Norman OK  
01/1999 – 12/2001

Ph.D in Electrical and Computer Engineering. Research topic was the development of a texture segmentation algorithm whose outputs are nested partitions. This research enabled the development of a multiscale framework for the identification and tracking of storms at different scales.

THE OHIO STATE UNIVERSITY Columbus OH  
08/93 – 06/95

M.S. in Biomedical Engineering concentrating on image processing and computer vision and their applications to medicine.

THE INDIAN INSTITUTE OF TECHNOLOGY Madras, India  
08/89 – 06/93

B.Tech. in Electronics & Communications Eng.

### Research & Development Experience

Architect of the Warning Decision Support System – Integrated Information (WDSS-II)<sup>1</sup>, a suite of multi-sensor machine-intelligence algorithms, tools and displays for research, weather analysis and severe weather warning decision-making. Uses C++, Java, J2EE, XML, CORBA, OpenGL and network programming on Linux and Windows (1999-)

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<sup>1</sup><http://www.wdssii.org>

Developed satellite multi-channel nowcasting technique under consideration for possible inclusion in GOES-R suite of algorithms (2008)

Designed and built an automated storm type classification system based on observed radar data (2007)

Designed and built geographic information systems (GIS) to display, monitor and disseminate warning and watch polygons (2006)

Designed and built a neural network to quality-control radar data (2003)

Designed and built a 4-D multisource merging process to assimilate information from multiple sensors. (2002)

Technical lead on team integrating four-dimensional weather data with terrain information. Uses C++, OpenGL, Geographical Information Systems (2000–2002)

Researched and developed a multiscale framework that enables the identification and tracking of storms at different scales and makes it possible to devise algorithms to detect weather signatures in specific (relative) locations within a storm. (1999–2001)

Technical lead on team driving requirements and design to develop a set of interfaces (Common Operational Development Environment) to streamline the development and incorporation of new weather detection algorithms in National Weather Service Offices around the country. Uses C++, XML. (1999–2000)

Designer and technical leader in developing a system that will pull in data from all the radar in a region and combine them for visualization and algorithm processing. This project (“OPUP”), for the Air Force Weather Service, was first deployed in 1999–2000 and represented a significant advance over current visualization and radar data handling. Uses C++, XML and Oracle. (1998–2000)

*Short (less than 6 mo.) projects and work completed before 2000 omitted for space reasons. Please see publications for a more complete list of R&D work.*

## **Honors**

Nominated by National Severe Storms Laboratory for Presidential Early Career Award for Scientists and Engineers (PECASE), 2006

NOAA Tech 2004 Award for Best Presentation in the category of Technology Transfer to Operations: “Real-time Dissemination of WSR-88D Radar Data over Internet2.”

Nominated for the National Oceanographic and Atmospheric Administration (NOAA)’s Technology Transfer Award, 1998.

University Fellow, The Ohio State University, 1993–94.

Third in the IIT, Madras Department of Electrical Engineering (of 75 students: top 5%) in 1989–1993.

Named among the top 1% of Indian high school graduates in 1989.

## **Grants**

Co-PI, \$950K National Science Foundation grant, “Real-time Data Mining,” 2002–05. PIs: Theodore Trafalis, Michael Richman, myself, S. Lakshmirarahan, Patrick Skubic (NSF ITR 0205628, 2002–2007).

PI, \$900K National Science Foundation grant, “Integrating 3D Dynamic Meteorological Data and Algorithms into a Scalable Geospatial Framework,” 2000–04. Collaborators: William Ribarsky

and Nicholas Faust of Georgia Tech Research Institute (NSF-CCF 9982299 for a total amount of \$1.9m, 2000-2004)

Co-PI, \$90K NOAA High Performance Computing (HPCC) Initiative, "Satellite Data Ingest and Visualization," 2002. PIs: Robert Rabin (NSSL) and myself

Co-PI, \$67K NOAA High Performance Computing (HPCC) Initiative, "Real-time Distribution of WDSS-II Algorithm Information", 2005. PIs: Russell Schneider (Storm Prediction Center) and myself

Co-PI, \$61K NOAA HPCC, "Four-dimensional Real Time CONUS radar products over the WWW", 2007. PIs: Kurt Hondl (NSSL) and myself

Co-PI, \$57K NOAA High Performance Computing (HPCC) Initiative, "Enabling Communication of WDSS-II Severe Storm Data Over a Network," 2004. PIs: Russell Schneider (Storm Prediction Center) and myself

Co-PI, \$30K NESDIS GOES-R Algorithms Working Group on Precipitation Nowcasting, 2007. PIs: Robert Rabin (NSSL) and myself

PI, \$30K USAID Disaster Mitigation and Recovery, 2007: Collaborators: Roy Bhomic (India Meteorological Department), Kurt Hondl (NSSL), Ming Xue (OU)

Co-PI, \$15K NASA Detection of Thunderstorms from Satellite Visible Imagery, 2007. PIs: Robert Rabin (NSSL) and myself

#### **Computer Skills**

- Software design, architecture, implementation and technical leadership experience using Object-Oriented methods.
- An expert in C++ , C and Java.
- Familiar with various technologies including Spring, JEE, JDBC, servlets, XML, CORBA, Qt, OpenGL; operating systems including UNIX and Windows; concepts including Object-Oriented Analysis and Design, design patterns and multithreaded programming.
- Instructor/author of corporate courses in: Spring Framework, Java security, Java Best Practices, JEE/J2EE Design Patterns, Java and XML, Object Oriented Design Patterns, Introductory Java Programming, Advanced C++ Programming and Design, Service Oriented Architectures and XML Web Services

#### **Panels, Invited Talks**

- Organizer, 2008 Artificial Intelligence Competition<sup>2</sup> Jan 2008
- Member, American Meteorological Society committee on Artificial Intelligence<sup>3</sup> 2004-2009
- Reviewer for National Science Foundation Dynamic Data Driven Applications program, Journal of Applied Meteorology, Journal of Oceanic and Atmospheric Technology, Weather and Forecasting, IEEE Transactions on Geoscience and Remote Sensing, Advances in Atmospheric Sciences (China)
- Invited talks at
  1. To GOES-R satellite compression working group *An Overview of Radar Compression*, Aug. 2007, San Diego, CA
  2. Short course on Artificial Intelligence *Machine Learning Techniques on Spatial Grids*, Jan. 2007, Corpus Christi, TX
  3. NEXRAD Technical Advisory Committee Meeting (Information Briefing) *Quality Control Neural Network*, Oct. 12, 2005, San Diego, CA.

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<sup>2</sup><http://nws.met.psu.edu/ai/AMS2008/index.html>

<sup>3</sup><http://www.ametsoc.org/stacpages/ai/>

4. Workshop on Severe Weather Technology for National Weather Service (NWS) Decision Making, organized by the NWS Meteorological Development Laboratory *WDSS-II: Aiding Severe Weather Forecasting*, July 13, 2005, Silver Spring, MD
  5. Int'l Conference on Advances in Pattern Recognition *Quality Control of Radar Reflectivity Data Using Texture Features and a Neural Network*, Dec. 13, 2003, Kolkata
  6. Los Alamos National Laboratory: *Fuzzy detection in Radar Images*, Jan 31, 1997
  7. University of Tulsa: *Electrical Engineering in Meteorological Research*, Oct 29, 1999
- One of two NSSL representatives in the working group on the Common Operational Development Environment. (1998–2000)

## Students

### Graduate Students:

- Jianting Zhang (Ph.D, Computer Science, 2002-04) now: Assistant Professor, City University of New York
- Angelyn Kolodziej (MS Meteorology, U. Oklahoma, in progress)
- John Cintineo (MS Meteorology, U. Oklahoma, in progress)
- Jennifer Newman (MS Meteorology, U. Oklahoma, in progress)

Committee: Shawn McCarroll (MS, ECE, 2008)

Undergraduate research: Becca Mazur (2003), Jennifer Green (2004), Angela Fritz (2005), Eric Guillot (2007), Chris Wilson (2008), John Cintineo (2008), Travis Visco (2009), Madison Burnett (2009)

## Journal Articles

T. Smith and V. Lakshmanan, "Real-time, rapidly updating severe weather products for virtual globes," *Computers and Geosciences*, p. subm., 2009.

S. Sen Roy, V. Lakshmanan, S. Roy Bhowmik, and S. Thampi, "Doppler radar based nowcasting of Cyclone Ognii," *J. Earth System Science*, p. acc., 2009.

V. Lakshmanan, J. Zhang, and K. Howard, "A technique to censor biological echoes in radar reflectivity data," *J. Applied Meteorology*, vol. 1, p. subm., 1 2009.

V. Lakshmanan and T. Smith, "Data mining storm attributes from spatial grids," *J. Ocea. and Atmos. Tech.*, p. Under review, 2008.

V. Lakshmanan, K. Hondl, and R. Rabin, "An efficient, general-purpose technique for identifying storm cells in geospatial images," *J. Ocean. Atmos. Tech.*, vol. 26, no. 3, pp. 523–37, 2009.

I. Adrianto, T. Trafalis, and V. Lakshmanan, "Support vector machines for spatiotemporal tornado prediction," *Int'l Journal of General Systems*, 2009. V. Lakshmanan, T. Smith, G. J. Stumpf, and K. Hondl, "The warning decision support system – integrated information," *Weather and Forecasting*, vol. 22, no. 3, pp. 596–612, 2007.

V. Lakshmanan, A. Fritz, T. Smith, K. Hondl, and G. J. Stumpf, "An automated technique to quality control radar reflectivity data," *J. Applied Meteorology*, vol. 46, pp. 288–305, Mar 2007.

N. Pal, A. Mandal, S. Pal, J. Das, and V. Lakshmanan, "Fuzzy rule-based approach for detection of bounded weak-echo regions in radar images," *J. Appl. Meteo. and Clim.*, vol. 45, no. 9, pp. 1304–1312, 2006.

V. Lakshmanan, T. Smith, K. Hondl, G. J. Stumpf, and A. Witt, "A real-time, three dimensional, rapidly updating, heterogeneous radar merger technique for reflectivity, velocity and derived products," *Weather and Forecasting*, vol. 21, no. 5, pp. 802–823, 2006.

V. Lakshmanan, "A separable filter for directional smoothing," *IEEE Geosc. and Remote Sensing Letters*, vol. 1, pp. 192–195, 7 2004.

V. Lakshmanan, R. Rabin, and V. DeBrunner, "Multiscale storm identification and forecast," *J. Atm. Res.*, vol. 67, pp. 367–380, July 2003.

V. Lakshmanan, "Speeding up a large scale filter," *J. of Oc. and Atm. Tech.*, vol. 17, pp. 468–473, April 2000.

V. Lakshmanan, "Using a genetic algorithm to tune a bounded weak echo region detection algorithm," *Journal of Applied Meteorology*, vol. 39, pp. 222–230, 2 2000.

C. Marzban and V. Lakshmanan, "On the uniqueness of gandin and murphy's equitable performance measures," *Monthly Weather Review*, vol. 127, pp. 1134–1136, June 1999.

V. Lakshmanan and A. Witt, "A fuzzy logic approach to detecting severe updrafts," *AI Appl.*, vol. 11, pp. 1–12, May 1997.

## Conferences

V. Lakshmanan and J. Zhang, "Censoring biological echoes in weather radar images," in *6th International Conference on Fuzzy Systems and Knowledge Discovery*, (Tianjin, China), IEEE, IEEE Computer Press, Aug. 2009.

V. Lakshmanan, "An overview of radar data compression," in *SPIE Optics + Photonics: Satellite Data Compression, Communications and Archiving III*, no. 07 in 6683, (San Diego, CA), SPIE, Aug. 2007.

V. Lakshmanan and K. Ortega, "A technique for creating probabilistic spatio-temporal forecasts," in *8th Int'l Conf. on Adv. in Patt. Recogn.*, (Kolkota), IEEE, Jan 2007.

V. Lakshmanan, I. Adrianto, T. Smith, and G. Stumpf, "A spatiotemporal approach to tornado prediction," in *Int'l Joint Conf. on Neural Networks*, (Montreal), p. CDR0M 1072, July 2005.

V. Lakshmanan, K. Hondl, G. Stumpf, and T. Smith, "Quality control of weather radar data using texture features and a neural network," in *5th Int'l Conf. on Adv. in Patt. Recogn.*, (Kolkota), IEEE, Dec 2003.

V. Lakshmanan, V. DeBrunner, and R. Rabin, "Nested partitions using texture segmentation," in *Southwest Symposium on Image Analysis and Interpretation*, (Santa Fe, New Mexico), IEEE, IEEE Computer Press, Apr. 2002.

V. Lakshmanan, V. DeBrunner, and R. Rabin, "Texture-based segmentation of satellite weather imagery," in *Int'l Conference on Image Processing*, (Vancouver), pp. 732–735, Sept. 2000.

V. Lakshmanan and A. Witt, "Detecting rare signatures," in *Artificial Neural Networks in Engineering ANNIE '97*, (St. Louis, MO), pp. 521–526, ASME Press, 1997.

V. Lakshmanan and A. Witt, "A fuzzy logic classifier for the detection of bounded weak echo regions in meteorological images," in *Artificial Neural Networks in Engineering ANNIE '96*, (St. Louis, MO), pp. 513–518, ASME Press, 1996.

V. Lakshmanan and A. Witt, "Detection of bounded weak echo regions in meteorological images," in *13th Int'l Conference on Pattern Recognition*, (Vienna), pp. 895–899, International Association of Pattern Recognition, 1996.

V. Lakshmanan and A. Witt, "A fuzzy logic scheme for the detection of bounded weak echo regions in meteorological images," in *IAPR Workshop on Machine Perception Applications*, (Graz, Austria), pp. 185–198, International Association of Pattern Recognition, 1996.

V. Lakshmanan and A. Witt, "Classification of skewed distributions: Detecting severe updrafts," in *Artificial Intelligence and Soft Computing*, (Banff, Canada), pp. 37–40, International Association of Science and Technology for Development, 1997.

V. Lakshmanan and T. Smith, "Lightning warning and prediction using observations and models," in *4th Conference on the Meteorological Applications of Lightning Data*, (Phoenix), p. 6.4, Amer. Meteor. Soc., Jan 2009.

V. Lakshmanan, J. Gourley, Z. Flamig, and S. Giangrande, "A simple data-driven model for stream-flow prediction," in *6th Conference on Artificial Applications to the Environmental Sciences*, (Phoenix, AZ), p. J6.2, Amer. Meteor. Soc., Jan 2009.

V. Lakshmanan, T. Smith, and R. Rabin, "Automated real-time extraction of storm properties from gridded fields," in *Preprints, Fifth European Conference on Radar in Meteorology and Hydrology*, (Helsinki), Finnish Meteorological Institute, June 2008.

V. Lakshmanan, J. Zhang, and C. Langston, "Quality control of canadian radar reflectivity data," in *Preprints, Fifth European Conference on Radar in Meteorology and Hydrology*, (Helsinki), Finnish Meteorological Institute, June 2008.

V. Lakshmanan, E. Ebert, and S. Haupt, "The 2008 artificial intelligence competition," in *6th Conference on Artificial Intelligence Applications to Environmental Science*, (New Orleans), p. 2.1, Amer. Meteor. Soc., Jan 2008.

V. Lakshmanan and R. Rabin, "Preprints, nowcasting of thunderstorms from GOES infrared and visible imagery," in *5th GOES Users' Conference*, (New Orleans), p. P1.73, Amer. Meteor. Soc., Jan 2008.

V. Lakshmanan and K. Hondl, "A polar-coordinate real-time three-dimensional rapidly updating merger technique for phased array radar scanning strategies," in *33rd Conference on Radar Meteorology*, (Cairns, Australia), p. 7.4, Amer. Meteor. Soc., Aug. 2007.

V. Lakshmanan, K. Ortega, and T. Smith, "Creating spatio-temporal tornado probability forecasts using fuzzy logic and motion variability," in *5th Conf. on Artificial Intelligence Appl. to Environ. Science*, (San Antonio, TX), Amer. Meteor. Soc., 2007.

V. Lakshmanan, T. Smith, K. Cooper, J. Levit, K. Hondl, G. Stumpf, and D. Bright, "High-resolution radar data and products over the continental united states," in *Preprints, 22th Int'l Conf. on Inter. Inf. Proc. Sys. (IIPS) for Meteor., Ocean., and Hydr.*, (Atlanta), Amer. Meteor. Soc., Feb 2006.

V. Lakshmanan and G. Stumpf, "A real-time learning technique to predict cloud-to-ground lightning," in *Preprints, Fourth Conference on Artificial Intelligence Applications to Environmental Science*, (San Diego), p. J5.6, Amer. Meteor. Soc., Jan 2005.

V. Lakshmanan, G. Stumpf, and A. Witt, "A neural network for detecting and diagnosing tornadic circulations using the mesocyclone detection and near storm environment algorithms," in *Preprints, 21st Int'l Conference on Information Processing Systems*, (San Diego), p. J5.2, Amer. Meteor. Soc., Jan 2005.

V. Lakshmanan, K. Hondl, D. MacGorman, and G. Stumpf, "Preprints, the use of lightning mapping array data in WDSS-II," in *22nd Conference on Severe Local Storms*, (Hyannis, MA), p. P14.3, Amer. Meteor. Soc., 2004.

V. Lakshmanan and M. Valente, "Quality control of radar reflectivity data using satellite data and surface observations," in *20th Int'l Conf. on Inter. Inf. Proc. Sys. (IIPS) for Meteor., Ocean., and Hydr.*, (Seattle), p. 12.2, Amer. Meteor. Soc., Jan 2004.

V. Lakshmanan, K. Hondl, G. Stumpf, and T. Smith, "Quality control of WSR-88D data," in *31st Radar Conference*, (Seattle), pp. 522–525, Amer. Meteor. Soc., Aug 2003.

V. Lakshmanan, "Motion estimator based on hierarchical clusters," in *19th Int'l Conf. on Inter. Inf. Proc. Sys. (IIPS) for Meteor., Ocean., and Hydr.*, (Long Beach, CA), Amer. Meteor. Soc., Feb. 2003.

V. Lakshmanan, "An extensible, multi-source meteorological algorithm development interface," in *21st Conference on Severe Local Storms*, (San Antonio, TX), Amer. Meteor. Soc., 2002.

V. Lakshmanan, "Statistical clustering for hierarchical storm identification," in *21st Conference on Severe Local Storms*, (San Antonio, TX), Amer. Meteor. Soc., 2002.

R. Lynn and V. Lakshmanan, "Virtual radar volumes: Creation, algorithm access and visualization," in *21st Conference on Severe Local Storms*, (San Antonio, TX), Amer. Meteor. Soc., 2002.

V. Lakshmanan, "Real-time merging of multisource data," in *21st Conference on Severe Local Storms*, (San Antonio, TX), Amer. Meteor. Soc., 2002.

V. Lakshmanan, "Real-time merging of multi-source data," in *19th Int'l Conf. on Inter. Inf. Proc. Sys. (IIPS) for Meteor., Ocean., and Hydr.*, (Long Beach, CA), Amer. Meteor. Soc., Feb. 2003.

V. Lakshmanan, R. Rabin, and V. DeBrunner, "Multiscale storm identification and forecast," *J. Atm. Res.*, vol. 67, pp. 367–380, July 2003.

V. Lakshmanan, "Lossless coding and compression of radar reflectivity data," in *30th International Conference on Radar Meteorology*, (Munich), pp. 50–52, American Meteorological Society, July 2001.

V. Lakshmanan, R. Rabin, and V. DeBrunner, "Segmenting radar reflectivity data using texture," in *30th International Conference on Radar Meteorology*, (Munich), pp. 50–52, American Meteorological Society, July 2001.

V. Lakshmanan, R. Rabin, and V. DeBrunner, "Identifying and tracking storms in satellite images," in *Second Artificial Intelligence Conference*, (Long Beach, CA), pp. 90–95, American Meteorological Society, 2000.

V. Lakshmanan and A. Witt, "Detecting bounded weak echo regions," in *28th International Conference on Radar Meteorology*, (Austin, TX), p. ???, American Meteorological Society, 1997.

*Non-refereed presentations as second author and higher omitted.*