

# Vipin VIJAYAN

## PROFILE

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Research engineer with strong background in machine learning, computer vision, network science, statistics, optimization, and algorithm design. Passionate about building machine learning models to solve real world problems in various fields.

## WORK EXPERIENCE

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<i>Current</i> MAY 2018	Machine Learning Engineer at KNOCKOUT CONCEPTS, Columbus, OH <i>Mobile 3D Scanning</i> Performed research and application development in various projects in the fields of 3D computer vision and machine learning. Projects include face landmark detection using convolutional neural networks (CNNs) and human 3D modeling using 3D morphable models.
DEC 2017–MAY 2018	Intelligent Systems Engineer at RIVERSIDE RESEARCH, Dayton, OH <i>Research and Development</i> Performed research and development in the fields of computer vision, deep learning, and machine learning. Projects included using and improving upon CNNs for face and object detection and recognition in low-power devices, as well as medical image analysis.
JUL 2010–MAY 2017	Graduate Research Assistant at UNIVERSITY OF NOTRE DAME, South Bend, IN Performed research in the fields of machine learning, computer vision, network science, data mining, biometrics, and bioinformatics. Projects included face recognition using 2D images and 3D scans, 3D reconstruction of faces from video, network/graph matching and comparison, and data visualization.
SUMMER 2014	Summer Intern at AIR FORCE RESEARCH LAB, Dayton, OH Performed research in computer vision, sparse representations, and dictionary learning.
SUMMER 2008	Summer Intern at VIRGINIA MODELING, ANALYSIS, AND SIMULATION CENTER, Suffolk, VA Performed research in the area of system dynamics.

## EDUCATION

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JUL 2012–MAY 2017	PhD in COMPUTER SCIENCE AND ENGINEERING <b>University of Notre Dame</b> Advisor: Prof. Tijana MILENKOVIC
JUL 2010–JUN 2012	MS in COMPUTER SCIENCE AND ENGINEERING <b>University of Notre Dame</b> Advisors: Kevin BOWYER and Patrick FLYNN
SEP 2005–DEC 2009	BS in PHYSICS and MATHEMATICS (double major) <b>Virginia Polytechnic and State University (Virginia Tech)</b>

## TECHNICAL SKILLS AND PROFESSIONAL COMPETENCIES

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- Fields: Machine learning, data science, network science, computer vision, algorithms. biometrics, bioinformatics.
- Skills: Deep learning, convolutional neural networks, supervised learning, unsupervised learning, dimensionality reduction, clustering, dictionary learning, data visualization, network analysis, graph matching, face recognition, object detection, algorithm design, data structures, non-linear optimization, probability and statistics, differential equations, linear algebra, distributed computing, parallel computing, relational databases.
- Languages: Julia, R, Python, Matlab, C++, C, Perl, bash, make,  $\LaTeX$ , SQL, Elixir.
- Tools: Linux, git, Docker, numpy, scikit-learn, PyTorch, TensorFlow, dlib, pthreads.
- Courses: Pattern Classification, Data Mining, Computer Vision, Design and Analysis of Algorithms.

## RESEARCH EXPERIENCE

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### RIVERSIDE RESEARCH

- 12/2017–05/2018 I conducted research focusing on machine learning and computer vision. Topics include:
1. *Face recognition*. The goal of this work was to implement a face recognition algorithm that can recognize new identities in an online manner in a low-power device.
  2. *Object detection and recognition*. The goal of this work was to implement an object detection and recognition algorithm in a low-power device.
  3. *Medical image analysis*. The goal of this work was to analyse a medical image dataset of ultrasound images and design an algorithm that automatically detects whether the image is of cancer tissue or not.

### UNIVERSITY OF NOTRE DAME

- 09/2014–04/2017 I conducted network alignment research focusing on biological networks. Topics include:
1. *Dynamic MAGNA++*. The goal of this research was to introduce a network alignment method that can align networks that evolve over time. I mentored an undergraduate student who participated in this project during Summer 2016. Funding: AFOSR, NSF.
  2. *Comparing network alignment methods*. The goal of this research was to determine which category of network alignment methods are more suitable for the task of knowledge discovery in bioinformatics. I mentored an undergraduate student who participated in this project for one year (Spring to Fall 2016). Funding: AFOSR.
  3. *MAGNA++*, *multiMAGNA++*. The goal of this research was to introduce a superior network alignment method that can be parallelized and align multiple networks, respectively. Funding: NSF, AFOSR, NIH.
- 07/2012–05/2014 I implemented a method to perform 3D reconstruction of a face from video or multiple 2D images. I used the 3D reconstruction to create synthetic images of the face from new angles in order to improve the performance of a 2D face recognition method. Funding: Scitor/SAIC.
- 07/2010–06/2012 I performed an evaluation of 3D face recognition methods to determine their viability and performance at distinguishing between identical twins while they vary their expressions. Funding: FBI/U.S. Army, ODNI, IARPA, ARL.

### AIR FORCE RESEARCH LABORATORY (WRIGHT-PATTERSON), DAYTON, OH

- 05/2014–08/2014 I compared two dictionary learning methods, K-SVD and Geometric Multi-Resolution Analysis (GMRA), in order to determine which method reconstructed images better.

### VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

- 01/2009–06/2009 Since a black hole loses mass over time, the orbits of a black hole-pulsar binary system will spiral outwards. I calculated the rate of change of the orbit radius given change in mass of two orbiting bodies, in order to determine whether they are detectable.

### VIRGINIA MODELING, ANALYSIS AND SIMULATION CENTER (VMASC)

- 06/2008–08/2008 I implemented a system dynamics model of the economy of a country using Simulink.

## RESEARCH PUBLICATIONS

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### JOURNAL PUBLICATIONS

**Vipin Vijayan** and Tijana Milenkovic, “Aligning dynamic networks with DynaWAVE”, *Bioinformatics*, 34(10):pp. 1795–1798, May 2018.

**Vipin Vijayan**, Dominic Critchlow, and Tijana Milenkovic, “Alignment of dynamic networks”, *Bioinformatics*, 33(14): pp. i80–i89, July 2017.

**Vipin Vijayan** and Tijana Milenkovic, “Multiple network alignment via multiMAGNA++”, *IEEE/ACM Transactions on Computational Biology and Bioinformatics (TCBB)*, doi: 10.1109/TCBB.2017.2740381, pp. 1–14, September 2017.

**Vipin Vijayan**, Vikram Saraph, and Tijana Milenkovic, “MAGNA++: Maximizing Accuracy in Global Network Alignment via both node and edge conservation”, *Bioinformatics*, 31(14): pp. 2409–2411, July 2015.

John H. Simonetti, Michael Kavic, Djordje Minic, Umair Surani and **Vipin Vijayan**, “A Precision Test for an Extra Spatial Dimension Using Black-hole-Pulsar Binaries”, *The Astrophysical Journal Letters*, 737(2): pp. 1–9, March 2012.

### CONFERENCE PUBLICATIONS

**Vipin Vijayan**, Dominic Critchlow, and Tijana Milenkovic, “Alignment of dynamic networks”, International Conference on Intelligent Systems for Molecular Biology and the European Conference on Computational Biology (ISMB/ECCB 2017), Prague, Czech Republic, July 21–25, 2017 (Oral presentation/talk, 2017 ISMB/ECCB Travel Fellowship Award).

**Vipin Vijayan** and Tijana Milenkovic, “Multiple network alignment via multiMAGNA++”, 15th International Workshop on Data Mining in Bioinformatics 2016 (BIOKDD 2016), in conjunction with ACM International Conference on Knowledge Discovery and Data Mining (SIGKDD 2016), San Francisco, CA, August 13–17, 2016 (Oral presentation/talk); International Conference on Intelligent Systems for Molecular Biology (ISMB 2016), Orlando, Florida, July 8–12, 2016 (Poster presentation).

**Vipin Vijayan** and Wesam Sakla, “An empirical comparison of K-SVD and GMRA for dictionary learning”, Proc. *SPIE Defense and Commercial Sensing Conference: Optical Pattern Recognition XXVI*, 94770J, pp. 1–9, Baltimore, MD, April 20, 2015.

**Vipin Vijayan**, Kevin Bowyer, and Patrick Flynn, “3D Twins and Expression Challenge”, in Proc. *13th International Conference on Computer Vision (ICCV 2011)*, *BeFIT Workshop*, Barcelona, Spain, pp. 2100–2105, November 13, 2011 (Oral presentation/talk).

**Vipin Vijayan**, Kevin Bowyer, Patrick Flynn, Di Huang, Liming Chen, Omar Ocegueda, Shishir K. Shah, and Ioannis A. Kakadiaris, “Twins 3D Face Recognition Challenge”, in Proc. *International Joint Conference on Biometrics (IJCB 2011)*, Washington DC, pp. 1–7, October 11–13, 2011 (Oral presentation/talk, Best Paper Award Nominee).

### OTHER RESEARCH PUBLICATIONS

**Vipin Vijayan**. “Novel Algorithmic Contributions and Evaluation Frameworks for Network Alignment with Applications in Computational Biology”. *Doctoral Thesis*, University of Notre Dame, May 2017.

**Vipin Vijayan**. “Three Dimensional Face Recognition of Identical Twins”. *Master’s Thesis*, University of Notre Dame, July 2012.

## RESEARCH PRESENTATIONS

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### POSTER PRESENTATIONS

International School and Conference on Network Science (NetSci 2017) (Indianapolis, Indiana)

International Conference on Intelligent Systems for Molecular Biology (ISMB 2017) (Prague, Czech Republic) (2017 ISMB/ECCB Travel Fellowship Award)

International Conference on Intelligent Systems for Molecular Biology (ISMB 2016) (Orlando, FL)

ISMB 2016 NetBio SIG

2013, 2014, 2015 University of Notre Dame CSE-SRS Poster Contest (2015 Student Choice Award Winner)

International Conference on Intelligent Systems for Molecular Biology and European Conference on Computational Biology (ISMB/ECCB 2015) (Dublin, Ireland)

ISMB/ECCB 2015 NetBio SIG

Great Lakes Bioinformatics Conference (GLBIO 2015) (West Lafayette, IN)

Air Force Research Lab (AFRL) 2015 Student Poster Session (Dayton, OH)

#### ORAL PRESENTATIONS

European Conference on Computational Biology (ECCB 2018) (Athens, Greece)

ACM Conference on Bioinformatics, Computational Biology, and Health Informatics (ACM-BCB 2018) (Washington, D.C.)

International School and Conference on Network Science (NetSci 2017) (Indianapolis, Indiana)

International Conference on Intelligent Systems for Molecular Biology and European Conference on Computational Biology (ISMB/ECCB 2017) (Prague, Czech Republic) (ISMB/ECCB Travel Fellowship)

ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD 2016) BOKDD Workshop (San Francisco, CA)

International Conference on Intelligent Systems for Molecular Biology (ISMB 2016) (Orlando, FL)

ISMB 2016 NetBio SIG (Orlando, FL)

International Conference on Computer Vision (ICCV 2011) BeFIT Workshop (Barcelona, Spain)

International Joint Conference on Biometrics (IJCB 2011) (Washington, DC) (Best Paper Award Nominee)

## TEACHING EXPERIENCE

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### TEACHING ASSISTANT

Design and Analysis of Algorithms, Fall 2015, University of Notre Dame.

Operating Systems Principles, Spring 2014, University of Notre Dame.

Basic Unix for Engineers, Spring 2014, University of Notre Dame.

### MENTORING

Research mentorship: mentored an undergraduate student over Summer 2016 and another undergraduate student during Spring, Summer, and Fall 2016, each of which resulted in a paper jointly authored with them.

## RELEVANT LINKS

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Homepage: <https://vipinvijayan.net/>

github: <https://github.com/vvjn>

LinkedIn: <https://www.linkedin.com/in/vipin255>