Curriculum Vitae

Siddhartha Agarwal, PH.D.

Assistant Professor: IIT-ISM

Mining Engineering & Artificial Intelligence

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PROFESSIONAL PROFILE

- Accomplished performer, speaker and with comprehensive blend of hands-on professional and academic experience. Mineral Risk Management and Economic Valuation
- Artificial Intelligence expert who is passionate about the potential and impact of Data Mining and its applications ranging from Geospatial data to Mine Planning & Design

EDUCATION:

- **PhD. Engineering Management & Systems** at Missouri University of Science & Technology, USA (2011- Aug 2015)
- **MS. Mining Engineering** from University of Alaska Fairbanks, USA May 2010
- **B.Tech. Mining Engineering** from Indian Institute of Technology- BHU, India, May 2006

Programming Skills: SURPAC, MINEX, SAS, R, SQL, TABLEAU, PYTHON, AWS, GSLIB

ACADEMIC HONORS AND AWARDS

- Recognized by Discover Financial for reducing the Fraud Losses by 35 % YOY and $7M 2017
- **Best Doctoral Thesis Award** by International Council of Systems Engineering ($5000-Cash) 2014
- **Best PhD Award** Missouri University of Science & Technology ($500-Cash) 2013
- Graduate Fellowship and Chancellor's Scholarship in MS and PhD 2008, 2012
- **National Science Foundation Grant** during PhD 2015, Accepted for the 13th Annual IIE Doctoral Colloquium, 2014, QC, Canada

Invited Key-Note SPEAKER

- **Presentation title:** Types of System of Systems and how they are modeled using Artificial Intelligence 26 *June 2019,* **INCOSE India Webinar**
- **Presentation title:** System of System Architecture for Fraud Investigation Tracking & Monitoring, **Complex Adaptive Systems conference,** *Nov 2018,* Chicago
- **Presentation title:** Architectural evolution through the computational intelligence: A module within Flexible and Intelligent Learning Architecture for SoS: **2nd Annual SERC Doctoral Students Forum**, *Dec 2014*, Washington D.C. https://sercuarc.org/serc-doctoral-students-forum-2014/

ACADEMIC/TEACHING EXPERIENCE

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1. **Assistant Professor** Department of Mining Engineering – Indian Institute of Technology ISM, Dhanbad **(March 2020-Present)**
    i. Computer Aided Mine Planning & Design (MEC-17103 and MNC 506)
        - B.Tech 7th Semester and M.Tech 1st Semester
    ii. Geostatistics and Mineral Valuation (MNC 508)
        - M.Tech 1st Semester
    iii. Systems Engineering (Linear Programming & Multi-objective Optimization)
    iv. Working on Govt of India National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS). CPS encompasses technology areas of Cybernetics, Mechatronics, Design and Embedded systems, Internet of Things (IoT), Big Data, Artificial Intelligence (AI) and many more.
2. **Teaching Faculty Missouri University of Science & Technology, 2013 to 2015**

- Taught Machine Learning, Neural Networks, Conduct workshop and seminars for graduate student

3. **Visiting Professor of Mathematics, Operations Research & Business Analytics, Teerthankar Mahavir University, Moradabad, Uttar Pradesh, 2010 to 2011**

    - Taught Regression & Analysis of Variance, Data Mining and Computer Vision and Image Processing

4. **Graduate Teaching Assistant University of Alaska Fairbanks, May 2008-2010**

    - Taught Computer Science, Mechanics, Probability and Statistics classes to undergraduate students in class sizes averaging 45 students. Evaluation of Midterms, Finals and Computer Laboratory Tests

RESEARCH INTERESTS

- Research interests are directed primarily towards these and a variety of interrelated areas:
  - ✓ Spatial Statistics
  - ✓ Mine Reserve Estimation and Planning & Scheduling
  - ✓ Artificial Intelligence/ Deep Learning
  - ✓ Operations Research
  - ✓ Applied Statistics / Business Analytics/ Big Data Analytics
  - ✓ Financial Risk Management of Insurance, Banking and Loan Products

Machine Learning	Linear regression, logistic regression, random forest, naive Bayes, SVM, hierarchical clustering, k-means clustering, NLP, Time Series, SVD/PCA, LDA, word2vec, Statistics hypothesis testing, Bayesian inference
Artificial Intelligence	Genetic Algorithms, Swarm Optimization, Fuzzy Logic, Neural Networks, Deep Learning

ENGINEERING, & PROFESSIONAL EXPERIENCE:

Indian Institute of Technology –Indian School of Mines, Dhanbad, Jharkhand, India

Assistant Professor Department of Mining Engineering – (March 2020- Present)

- Computer Aided Mine Planning and Design (SURPAC, MINEX)
  - Mine Reserve estimation through Block Modeling, IDW, Kriging
- Big Data Analytics & Machine Learning
- Systems Engineering (Linear Programming & Multi-objective Optimization)

Asurion LLC (Nashville, TN)

Manager Product Risk Management & Cybersecurity (Sep 2018– Present)

- **Leading my team to use a combination of logic, analysis and relevant experience to analyze data, effectively assessing a situation and accurately defining the problem/opportunity, and scope of the analysis**
- Examine leads and customers per channel to determine valuable traffic using metrics such as: bounce rate, visitors per channel over the previous six months, time to customer conversion, amount, timing & frequency of email sends, click through rates etc.

- Identifying the channels video, web that generate the most leads and sales by tracking how much revenue is generated from each channel, hence select marketing tactics are delivering the best return on investment.
- Clickstream analysis for pages visited, time spent, next page visited, IP, Browser, language used in the browser, number of clicks on each page, browsing pattern for customer behavioral pattern analysis
- Champion client needs and ensure the alignment of Asurion strategy with client direction and have detailed knowledge of the client's business: operational, financial and business drivers
- Subject Matter Expert for Mobility and Retail Fraud in USA, Asia Pacific, Latin America, Canada
- **Develop the analytical capability of the organization by continually upgrading the tools, systems and analytical thinking of senior leaders on claim analytics and fraud management**
- Support the organization in Subscriber Growth and reduce Churn, Increase our Customer interaction through digital channels: Asurion Virtual Assistant and WEB
- **TABLEAU and POWER BI (**Aggregate data across multiple sources to develop ad hoc and standardized reporting solutions supporting the business.)

Discover Financial Services (Chicago, IL)

Manager/AVP, Consumer Banking Fraud Strategy (Aug 2016 – Aug 2018)

- Directly Report to Chief Risk Officer
- **Led a global team of 8 (Project Manager's and Sr. Associates)** as well as Vendor model team-lead responsible for strategy, operations and infrastructure and reporting covering all fraud classes.
- Lead and Manage the Retail Fraud Investigations Unit for consisting of **$50 Billion portfolio and was able to prevent $7M in fraud losses, $2M in operational opportunity costs.**
- Coordinate and work in tandem with Operational Risk Management, Compliance, AML, Statutory Reporting, Internal Audit, IT & Legal teams for framing proactive risk-based alert generating system for mitigating Internal & External frauds effectively
- Developed strategies using machine learning **(Naïve Bayes, Random Forest), logistic regression and build decision trees** for First Party, Fraudulent Application and Account Takeover fraud types
- Generated Fraud alerts for accounts based on 1000 attributes such as: Customer Relationship, Large Check, Multiple Accounts, Failed Customer Personal Information, Compromised Cards, Global Negative List, Velocity of Transactions, Large Check Deposit, Accounts Created Per Device 6+ in 30 days, Transactions per IP, Internet Service Provider, cookies, screen resolution, Login Behavior etc.
- Score transactions for debit card Transaction: Decline/Approve swiped transactions or Cashback Authorization based on (PINless or PIN), merchant category (Grocery, ATM, SuperMarket etc.), transaction amount and account holder state, merchant state

- Network with several other banks, financial institutions and law enforcement agencies to trace and track financial crimes like skimming, carding, identify thefts and cybercrimes.
- Build Key Risk Indicators (KRI) in Tableau to analyze the Fraud exposure trend in different segments (ACH, Check Wires, Overdrafts)
- Disputes Process Handling Investigates Cardmember (CM) disputes and fraud claims in accordance with regulatory requirements. Investigate Customer inquiry – either handling of a claim or a response to a request for contact/ verification (Inbound Call)

Discover Financial Services (Chicago, IL)

Sr. Associate, Scorecard & Credit Risk Portfolio Management (2015 – Aug 2016)

1. **Led a global team in US and China of 4 (Associates)** CCAR/DFAST modeling for $20 Billion personal loans
2. **Probability of Default /Loss Given Default /EAD Models using regression and time series**
3. Forecast life of loan losses: Loss rate is calculated by three components – Maturation curve, Vintage quality and Exogenous impact
4. Monthly credit risk performance based on acquisition, portfolio, delinquencies, Vintage tracking, and Payments Program
5. Maintaining loan book (interest rate, average FICO, average receivables, charge off $) by model segment, FICO, loan status, months in repay, Cosigner status
6. Loan Risk Screening Underwriting Criteria (Cross Sell and Broadmarket)
7. Stress Testing Model validation -back testing, cross validation. Sensitivity testing is performed to assess the sensitivity of model output to macroeconomic changes. Base, Adverse and Severely Adverse macroeconomics variable scenario analysis

MITRE Corporation & USA Department of Defense (DoD) (Washington DC)

Supply Chain and Risk Management of Large-Scale Systems (July 2011-May 2014)

1. Principal integrator and Project manager for a team of 25 from USA, France and Italy Members included Boeing Managers, MITRE, DoD, faculty from Stevens Institute, AirForce Institute, Penn State, Georgia Tech, Ecole Polytechnic
2. Supply Chain Optimization using Evolutionary Algorithms. Genetic algorithms and swarm optimization techniques were used to generate different architectures. This research helped DOD with a $25M+ acquisition

3. Fuzzy logic approach to accommodate diverse stakeholder views and convert them to key performance parameters (KPP) and use them for architecture assessment.
4. Built a computational negotiation method for a multi-issue buyer-seller adaptive negotiation. The behavior of seller could be clustered into co-operative, semi-cooperative and aggressive using K-means, Hierarchical Clustering. Furthermore, Radial Basis Networks was used to train and for Predicting Negotiation Behaviors

Mintec Inc. (Tucson, AZ) MINESIGHT SOFTWARE

Engineering Consultant (2010 June -Nov)

1. Managed a mining portfolio of clients for consulting related to mine planning and development
2. Developed custom performance reports, financial models and analysis using SAS, Visual Basic, Access and SQL databases from data warehousing environments to meet business requirements.
3. Interpreted and analyzed data in support of direct and relationship marketing strategy development.
4. Improved mine surface designs based on drill hole data and incorporate additional techniques.

State Department of Natural Resources (USA)

Mining Engineering & Portfolio Management (2009 – Jan 2010)

1. **Managing Compliance for Land Conservation and Reclamation Act (SMLCRA)**
2. Develop Plan of Operations with measurable, reasonable, practicable, and necessary performance standards.
3. **Evaluation of Reclamation bonds, sureties, or other financial guarantees different organizations each worth more than a $100 M**

Steel Authority of India Ltd

Project Management & Analytics (July 2006-June 2008)

1. Led a team of over **50 supervisors and operators in Bhilai Steel Plant Process and Operations**
2. Managed s**upply chain of fleet and workforce allocation optimization solution** enabling real-time monitoring. Erection and commissioning of transportation lines for 6 MTPA Steel Making Plant.
3. Linear regression in predicting production rate based on no. of machines, air quality index, no. of operators, ore density, availability of ore crusher

COURSES TAUGHT

Courses:

- Opencast Mining
- Mine Planning & Design
- Mineral Exploration and Geostatistics
- Environmental Aspects of Mining
- Mine Design Methods by Software Vulcan 3D /Minesight
- Regression & Analysis of Variance
- Computer Vision and Image Processing
- Computer Programming C++/ MATLAB/SAS/R/PYTHON
- Probability and Statistics
- Operations Research
- Data Mining Techniques and its Applications

Cited by

	All
Citations	131
h-index	7
i10-index	4

SCHOLARLY CONTRIBUTIONS

1. A. Gosavi, S. Agarwal and C. H. Dagli, "Predicting Response of Risk-Seeking Systems During Project Negotiations in a System of Systems," in IEEE Systems Journal, vol. 11, no. 3, pp. 1557-1566, Sept. 2017.

2. S Agarwal, D Rastogi, A Singhal. The Era Of Neurosynaptics: Neuromorphic Chips and Architecture, European Scientific Journal, June 2015 /Special/ Edition Vol.

3. S Agarwal, LE Pape, CH Dagli. A hybrid genetic algorithm and particle swarm optimization with type-2 fuzzy sets for generating systems of systems architectures, Procedia Computer Science 36, 57-64.

4. Wang, R., Agarwal,S., & Dagli, C., Executable System of Systems Architecture Using OPM in Conjunction with Colored Petri Net: A Module for Flexible Intelligent & Learning Architectures for System of Systems, INCOSE International Symposium 24 (s1), 581-596, 2014.

5. S Agarwal, L Pape, C Dagli, N Ergin, D Enke, A Gosavi, R Qin, D Konur. Flexible and intelligent Learning Architectures for SoS (FILA-SoS): Architectural Evolution in Systems-of-Systems, Procedia computer science 44, 76-85.

6. L Pape, S Agarwal, C Dagli. Selecting Attributes, Rules, and Membership Functions for Fuzzy SoS Architecture Evaluation. Procedia Computer Science 61, 176-182-3, 2015.

7. Agarwal,S,. Saferpour, H., & Dagli, H.C,. Adaptive Learning Model for Predicting Negotiation Behaviors through Hybrid K-means Clustering and Linear Vector Quantization Approach, Procedia Computer Science 36, 285-292.

8. Agarwal,S,. Pape, E. L, Ergin, N., & Dagli.H.C, Multi-agent Based Architecture for Acknowledged System of Systems, Procedia Computer Science, Volume 28, 2014, Pages 1-10, ISSN 1877-0509.

9. Pape, E. L., Agarwal, S., Giammarco, K., & Dagli, H.C, Fuzzy Optimization of Acknowledged System of Systems Meta-architectures for Agent based Modeling of Development, Procedia Computer Science, Volume 28, 2014, Pages 404-411, ISSN 1877-0509.

10. Agarwal,S,. Pape, E. L, & Dagli, H.C, A Hybrid Genetic Algorithm and Particle Swarm Optimization with Type-2 Fuzzy Sets for Generating Systems of Systems Architectures, Procedia Computer Science 36, 57-64.

11. Agarwal S,. Computational intelligence based complex adaptive system-of-systems architecture evolution strategy. Missouri University of Science and Technology. 2015, PhD Thesis.

12. R Wang, S Agarwal, CH Dagli. OPM & color petri nets based executable system of systems architecting: A building block in FILA-SoS. Systems Conference (SysCon), 2015 9th Annual IEEE International, 554-561,6, 2015.

13. Agarwal, S., & Dagli, C. H. (2013). Siddhartha Agarwal, Cihan H. Dagli, Augmented Cognition in Human–System Interaction through Coupled Action of Body Sensor Network and Agent Based Modeling, Procedia Computer Science, Volume 16, 2013, Pages 20-28, ISSN18770509.

14. Agarwal, S., Reale, G., & Dagli, C. H. (2013). An Approach to Advance Higher Order Cross-cultural Awareness in Dismounted Soldiers, Procedia Computer Science, Volume 20, 2013, Pages 216-222, ISSN 18770509.

Papers in Review:

15. Predictive Modeling of spontaneous combustion susceptibility of coal in Jharia Coalfields: A Machine Learning approach, D. C. Panigrahi, Siddhartha Agarwal, V.K. Saxena.
16. Designing cast blasts for effective dragline operation using deep domain knowledge and machine learning tools, Sheo Shankar Rai, VMSR Murthy , Siddharth Agarwal, Nalamas Sukesh, A Sairam Teja
17. Data Mining and Analysis of Greens Creek (Alaska) Ore using Hybrid Particle Swarm Optimization and Neural Networks. Siddhartha Agarwal, D.C. Panigrahi, B.C. Sarkar

Book Chapters:

1. Agarwal,S., Wang, R., & Dagli, C., FILA-SoS, Executable Architectures using Cuckoo Search Optimization coupled with OPM and CPN-A module: A new Meta-Architecture Model for FILA-SoS, France, Complex Systems Design & Management (CSD&M), Springer Berlin Heidelberg, 2014.

2. S Agarwal, CH Dagli, LE Pape. Computational intelligence based complex adaptive system-of-system architecture evolution strategy- France, Complex Systems Design & Management, 2016 – Springer Berlin Heidelberg.

Book Editor: Analysis and Modeling of Complex Adaptive Systems

Currently working on compiling papers from Various Authors

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Technical Reports Published:

Enterprise Systems and Systems of Systems (ESOS) Modeling and Analysis For:

Flexible Intelligent Learning Architectures for Systems of Systems (FILA-SoS)

http://www.sercuarc.org/technical-reports/enterprise-systems-and-systems-of-systems/

Phase I Technical Reports:

- SERC-2012-TR-021-1 An Advanced Computations Approach to SOS Analysis

Phase II Technical Reports:

1. SERC-2013-TR-021-2 An Advanced Computations Apporach to SOS Analysis
2. SERC-2013-TR-021-3 An Advanced Computations Apporach to SOS Analysis

Phase III Technical Reports: Volume 1-14

3. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 1 – 1Integrated Model Structure
4. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 2 – Meta-Architecture Generation Multi-Level Model
5. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 3 – Fuzzy Genetic Optimization Model
6. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 4 – Architecture Assessment Model
7. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 5 – Cooperative System Negotiation Model
8. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 6 – Non-Cooperative System Negotiation Model
9. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 7 – Semi-Cooperative System Negotiation Model
10. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 8 – Incentive Based Negotiation Model for SoS
11. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 9 – Building Executable Architecture on Notational SoS
12. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 10 – Integrated Model Software Architecture

13. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 11 – Integrate Model Structures for FILA-SoS Version 2.0
14. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 12 – Architecture Evolution Strategy for FILA-SoS Version 2.0
15. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 13 – Meta-Architecture Generation Model: Flexible Architecting
16. SERC-2015-TR-021-4 Flexible and Intelligent Learning Architectures for SoS (FILA-SoS) Volume 14 – FILA-SoS v2.0: Impact of Different Cooperativeness Levels

Research Posters, Workshops & Presentations:

1. Agarwal,S. & Dagli, H.C , Flexible and Intelligent Learning Architectures for SoS (FILA-SoS): Architectural evolution in Systems-of-Systems, INFORMS Annual Meeting, San Francisco, Nov 2014.
2. Agarwal,S. & Dagli, H.C , Predicting Negotiation Behaviors through Hybrid K-means Clustering and Linear Vector Quantization Approach , 2nd Annual SERC Doctoral Fellows Forum and 6th Annual SERC Sponsor Research Review, Washington D.C. 2014. (Accepted)
3. Agarwal,S. & Dagli, H.C, Particle Swarm Optimization with Type-2 Fuzzy Sets for Generating Systems of Systems Architectures, ISERC, IIE Annual Conference & Expo, Montreal, 2014.
4. Agarwal,S. & Dagli, H.C, Adaptive Negotiating Strategies of Systems of Systems Coordinator using Deep Belief Networks, CESUN 2014, Steven's Institute of Technology, Hoboken, NJ. 4th International Engineering Systems Symposium.
5. Agarwal, S. & Dagli, C. H. (2013). A Conceptual Architecture for Modeling Team Cognition by Haptic Sensors and Agent Based Simulation, ISERC 2013 Conference, San Juan, Puerto Rico.
6. Agarwal,S. & Ganguli., R. Automated Modeling of Real Time Mine Operations Data Using Neural Networks, UAF CEM Mining Engineering Alaska Miners Association Fairbanks 22nd Biennial Conference, 2010.

PROFESSIONAL SERVICE

1. Have served on the review and program committee of IEEE Systems Engineering Conference for 2015, 2016
2. Reviewer for International Journal of Systems Engineering, Wiley Publications
3. Reviewer for Complex Adaptive Systems Conference

PROFESSIONAL SOCIETIES

Life Member INCOSE (International Council on Systems Engineering)

Life Member INFORMS (Institute for Operations Research and the Management Sciences)

SIGMA XI society Membership

PhD DISSERTATION ABSTRACT

Supply Chain Management of Systems by Multi-Objective Optimization and Adaptive Negotiation Strategies

Classically all supply chain problems are characterized by decisions that are contradictory by nature. Multiple objective modeling in such problems result in Pareto optimal solutions which gives the decision maker a set of non-dominated solutions to choose from. Since last two decades, evolutionary algorithms (EA) have successfully been applied to single and multi-objective optimization problems. Evolutionary multi-objective algorithms (MOEAs) are powerful in achieving multiple non-dominated solutions in a single run when the number of objectives is less than or equal to three. But the performance starts to reduce considerably when objectives are larger than three which are known as many-objective optimization problems (MaOPs). Most real world problems are MaOP and hence need meta-heuristics in solving them which include:

a. the inability of dominance-based MOEAs to converge to the Pareto frontier while maintaining good diversity,

b. computational time,

c. difficulty for decision makers to balance the tradeoff between objectives

d. And the visualization of complex objective space.

My research has attempted to address all these issues by using genetic algorithms and incorporating fuzzy rules as a methodology to incorporate multiple and diverse stakeholder views, as well as evaluate the fitness of the objective function, decrease computational time, maintain diversity as well as visualize the complex solution space.

The other problem addressed by my research is negotiations between multiple systems to achieve a common objective. The controlling authority for the common objective is called a System of Systems. The systems have their own selfish interests, capabilities, and network limitations. These negotiations are based on numerous attributes which are specific to the domain such as cost, performance, individual unique capability, networking interfaces etc.

A new automated negotiation protocol between the System of Systems (SoS) and the all the participating systems is developed using clustering and neural networks.

Each solution generated by the MOEA is assessed by a type II fuzzy inference engine to calculate its quality. Further these solutions form a large mete-architectural space which are then implemented through multi-attribute negotiation. The research aims to address three major topics in System of Systems (SoS) meta-architectures by: 1) exploring development of a domain independent framework for generating SoS meta-architecture through evolutionary algorithms; 2) building a domain dependent technique for evaluation of SoS meta-architecture quality using Type II fuzzy nets and finally; 3) creating, for implementation of the meta-architecture, a behavior dependent adaptive strategy designed for the SoS coordinator to negotiate effectively with participating systems.

The basis for SoS manager's adaptable negotiation strategy stems from neural networks and machine learning algorithms. An unsupervised clustering of the difference between offer and counteroffer of attributes by hierarchical and a k-means clustering technique reveals optimal numbers of clusters present in the data. The clustering results indicate the presence of prominent behaviors as selfish, semi-cooperative, opportunistic, and extremely selfish. A radial basis network is trained in based on these clusters as centers of the nodes.