



Alice E. Smith, IEEE Fellow (2023-2025)

Joe W. Forehand/Accenture Distinguished Professor
Industrial and Systems Engineering Department
Auburn University
Homepage: <https://www.eng.auburn.edu/~aesmith/>
e-mail: smithae@auburn.edu

Topic 1: Decision Science Inspired by Nature

Abstract: This talk will put forth several straightforward but successful implementations of analytical approaches inspired by natural systems. These nature-based paradigms range in fidelity with their natural systems origins but all seek to leverage the structures and operations of nature doing what it does best – novelty detection, system optimization, adaptability to dynamic environments, robustness, and flexibility. More specifically, the well-known, but often misunderstood and misused, natural system computational paradigms of artificial neural networks, fuzzy logic, and evolutionary algorithms will be considered for use in decision science. Used judiciously and knowledgeably these approaches can offer significant advantages in diverse decision environments. A curated selection of diverse applications from the speaker’s more than 25 years of experience in this field will be explained and objectively analyzed. The applications are (1) quality and process improvement of large-scale ceramic casting, (2) real-time placement of drones for ad hoc network connectivity, (3) continuous monitoring of vehicles for predictive maintenance, (4) the location of semi-obnoxious facilities in municipalities considering transport costs and social costs, and (5) the design of large order picking warehouses considering travel distance.

Topic 2: Evolutionary Strategies for Design Of Engineered Systems

Abstract: This presentation will put forth several straightforward but successful implementations of an often overlooked evolutionary algorithm – evolutionary strategies, ES – for the design of complex systems. ES was developed more than 50 years ago for optimizing engineering design problems in continuous space and is characterized by its simplicity and computational efficiency. There are few tunable parameters in the basic version and the search relies on the evolution of a population through mutation only, where mutation is a Gaussian which adapts automatically to the search history. Such simplicity is appealing for both algorithm development and implementation and tends to result in a robust search. The three engineering design problems showcased in this talk are diverse and two of them are bi-objective optimized to identify a Pareto set of non-dominated designs. The applications are (1) the design of an airfoil for a flying drone considering drag and lift, (2) the location of semi-obnoxious facilities in municipalities considering transport costs and social costs, and (3) the design of large order picking warehouses considering travel distance.

Topic 3: Nature Guided Design Optimization in Continuous Space

Abstract: This presentation will put forth four straightforward, but successful implementations of natural systems inspired optimization for the design of complex systems in continuous (or real) valued spaces. These nature-based paradigms range in fidelity with their natural systems origins but seek to leverage the structures and operations of nature doing what it does best –system optimization, adaptability to dynamic environments, robustness, and flexibility. More specifically, the well-known, but often misunderstood and misused, natural system computational paradigms of evolutionary strategies and particle swarm optimization will be considered. The four diverse applications are (1) the location of semi-obnoxious facilities in municipalities considering transport costs and social costs, (2) the design of large order picking warehouses considering travel distance, (3) the design of an airfoil for a flying drone considering drag and lift, and (4) ad hoc network connectivity through drone positioning.

Topic 4: Bi-Objective Evolutionary Strategies for Design Optimization

Abstract: This presentation will put forth three straightforward but successful implementations of an often-overlooked evolutionary algorithm – evolutionary strategies, ES – for the design of engineering systems where more than one objective is considered. ES was developed more than 50 years ago for optimizing engineering design problems in continuous space and is characterized by its simplicity and computational efficiency. There are few tunable parameters in the basic version and the search relies on the evolution of a population through mutation only, where mutation is a Gaussian which adapts automatically to the search history. Such simplicity is appealing for both algorithm development and implementation and tends to result in a robust search. The three engineering design problems showcased in this talk are diverse and are optimized to identify a Pareto set of non-dominated designs. The applications are (1) the design of an airfoil for a flying drone considering drag and lift, (2) the design of heterogeneous communications networks, and (3) the location of semi-obnoxious facilities in municipalities considering transport costs and social costs.

Topic 5: Facility Design of Order Picking Warehouses Using Evolutionary Strategies

Abstract: This seminar will discuss the formulation and solving of the order picking warehouse design problem. Design variables include the number and placement of both the cross aisles and the pick aisles, the location of the depot, and the aspect ratio of the warehouse for a given storage capacity. For a candidate design, product is allocated to storage location using a new algorithm and then designs are evaluated with a sampling of possible orders by shortest path routing through the candidate warehouse design. The shortest path algorithm has been adapted to reflect human preferences in moving through such a warehouse using a visibility graph. This problem is complex both from an algorithmic perspective and from a computational perspective. We address these challenges through smart order sampling and an efficient meta-heuristic using an innovative encoding and problem decomposition, and also through distributed and parallel computing. Results indicate that many designs currently used in practice are surprisingly effective even though they are simplistic and obvious. However, for certain warehouse environment characteristics non-traditional designs can offer operational advantages. Furthermore, the new travel distance metric of the visibility graph can better reflect actual movement than the traditional aisle center method and can influence the selection of the best design.

Topic 6: Drones For Last Mile Logistics with A Medical Humanitarian Application

Abstract: This webinar discusses two novel strategies for employing a combination of drones and delivery vehicles, such as trucks, for last mile delivery to homes and businesses. The work is general, but we aim for a healthcare application. The first strategy uses a drone to resupply a truck during the day for same day delivery, as orders are made available at a central depot. The truck delivers the orders to the customers but does not have to return to the depot during the day since it is being supplied by the drone for new orders. The second strategy integrates a truck with a drone. In this case, either the truck or the drone can make both deliveries and pick-ups, and the drone is launched from and returned to the truck. A mathematical model is formulated and solved for each strategy. We show that both strategies offer benefits in customer service and cost of delivery compared to traditional truck delivery only. We focus our work on healthcare and specifically the delivery and pick up of medical supplies and tests (such as COVID tests) in challenged, rural environments. We are complementing our algorithmic and computational work with a limited field trial.

Topic 7: Understanding The Journal Paper Process and Writing Papers That Will Be Chosen For Publication (designed for PHD students and newer faculty members, not a research presentation)

Abstract: This talk will give an overview of the journal structure and reviewing process. It will discuss approaches that will facilitate the writing of successful papers. Writing and handling reviews effectively will also be covered. This presentation is designed to help students and professors organize their research properly for publication and to develop papers which are likely to be accepted in mainstream, respected journals, and to engage the academic journal system productively. Much of the content of this talk is from the comprehensive website: <http://journalpubs.auburn.edu/> .

Topic 8: Women in Computational Intelligence – Current Research

Abstract: This is a mini talk that can be combined with other talks or as part of a forum. This discusses the recent volume published by Springer – Women in Computational Intelligence. Overview of the content and authors, and how the biographies and messages to young people can broaden the participation in our field.