July 15, 2025

Windborne Systems
Palo Alto, CA

Dear WindBorne Hiring Team,

I recently completed my Ph.D. in Aerospace Engineering at the University of Texas at Austin. In my dissertation research, "Recursive Measurement Updates for Particle and Ensemble Filtering," I explored estimation techniques with applications to large-scale systems, onboard navigation, and space object tracking. I'm so excited about all the interesting work going on at WindBorne; from your fascinating propulsion-free autonomous navigation system to AI-based data assimilation. With my experience in modeling and simulation, aerospace navigation and tracking, and data assimilation, I believe I could be a Day 1 contributor to the growing WindBorne team.

I developed numerous simulations of aerospace systems during my Ph.D. Many of these are detailed in the technical publications listed in my resume. In a coursework project entitled "Multi-Robot Source Seeking in Dynamical Flowfield: A Game Theoretic Approach," I modeled a multi-agent pursuit-evasion game in which agents' trajectories are influenced by forces from a flow field (e.g., a wind field). This work is highly related to the tasks of: (1) navigating a balloon to a specific location, and (2) deciding *which* balloon to assign to *which* location.

The bulk of my dissertation research focused on multiple data assimilation (MDA), a data assimilation technique for ensemble Kalman filters and smoothers. In MDA, the data assimilation process is "broken up" into a set of discrete steps for each measurement. The experimental success of the algorithm has spurred much contemplation that it is a maximum *a posteriori* (MAP) estimator, though proof for nonlinear measurements has not been forthcoming. In my paper "Multiple Data Assimilation as an Approximate Maximum A Posteriori Estimator" (*Computational Geosciences,* 2025), I shed new light on the optimality of MDA by deriving it as a homotopy between the prior state estimate and the MAP. To my knowledge, this is the most complete discussion available on the optimality of the MDA update.

I also extended these ideas to particle flow, a particle filtering technique in which particles (i.e., ensemble states) "flow" from the prior distribution to the Bayesian posterior distribution at measurement time. The prior distribution is the initial estimate of the uncertainty distribution, and the posterior distribution is the the new uncertainty distribution after the data is assimilated. Particle flows, often defined as stochastic differential equations, are similar to iterative denoising schemes in diffusion models. I really enjoyed reading "WeatherMesh-3: Fast and Accurate Operational Global Weather Forecasting," as well as "WeatherMesh-4 Technical Blog" and "WindBorne AI DA" on the blog. I am very interested in learning about AI-based weather prediction, and I would love to contribute to future technical papers (and awesome blog posts!) as a WindBorne author.

Thank you in advance for your time and consideration.

Sincerely,

Kristen Michaelson, Ph.D.