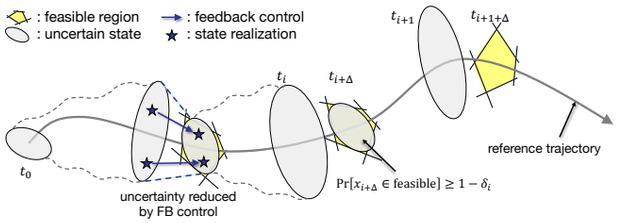
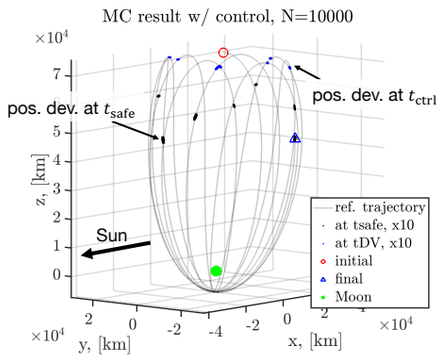
Robust stationkeeping control on unstable orbits (Ken Oguri)

Concept: find optimal feedback policy
w/ safety constraints & minimum expected fuel cost



Monte Carlo simulations:
stationkeeping on an EML2 Halo orbit
w/ the optimal feedback policy

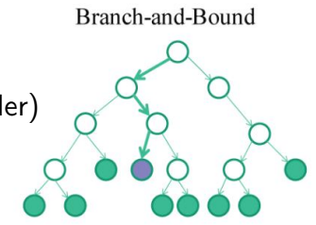


Originally non-convex problem
→ two convex problems w/ a dynamical approximation

$$
\begin{aligned}
(\mathrm{P}) \quad \min_{K_i, \Sigma_i^x, \Sigma_i^y, X_i, \forall i} \quad & \sum_{i=1}^{N} \left\| \hat{B} K_i X_i \right\|_2 \qquad \text{original problem: non-convex} \\
\text{s.t.} \quad & \Psi_{i,k} \sqrt{s_k^T \Phi_i^{i+\Delta} \Sigma_i^y \Phi_i^{i+\Delta^T} s_k} - d_{i,k} \leq 0, \quad \forall k, i \quad \text{(safety)}, \\
& \Sigma_i^y - (I_6 + \hat{B} K_i) \Sigma_i^x (I_6 + \hat{B} K_i)^T - \hat{C} \Sigma_i^w \hat{C}^T = 0, \quad \forall i \quad \text{(dynamics 1)}, \\
& \Sigma_{i+1}^x = \Phi_i^{i+1} \Sigma_i^y \Phi_i^{i+1^T}, \quad X_i X_i^T = \Sigma_i^x, \forall i \quad \text{(dynamics 2)},
\end{aligned}
$$

NBA DraftKings optimal lineup selection

(Cheryl Hansen, Nelson Mitchell, Tyler Schuessler)



Each node in branch-and-bound is a new MIP

Greedy Algorithm				
Sample Lineups			Avg. Optimal $f(x)$	Avg. Cost
Anthony Davis	Cameron Payne	Andre Roberson	−121.7736	$43,460
Cody Zeller	Cody Zeller	Anthony Davis		
Damion Lee	Danilo Gallinari	Cameron Payne		
Danilo Gallinari	DeAndre Bembry	Chandler Parsons		
Harrison Barnes	DeMarcus Cousins	Isaiah Canaan		
Isaiah Thomas	Dorian Finney-Smith	Jabari Parker		
Klay Thompson	John Wall	Tyson Chandler		
Mike Muscala	Michael Carter-Williams	Zach LaVine		

Sparse Optimization (background subtraction)
(Will Shand)

APPM 4720/5720 (special topics)
"Advanced Convex Optimization"
Prof. Becker, fall 2018
Student projects

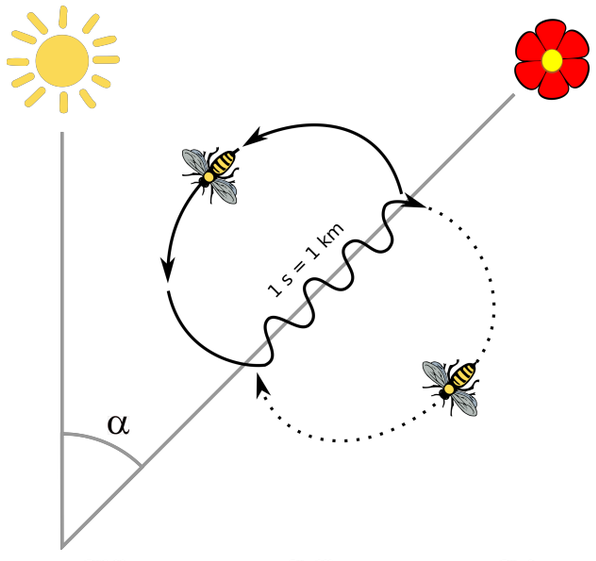
Student backgrounds:

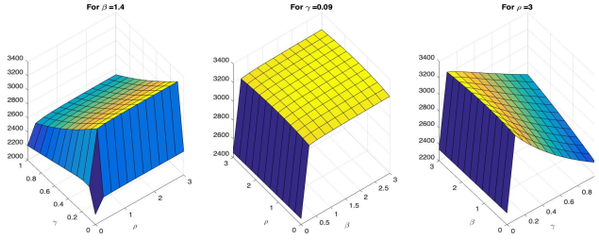
- Applied Math (BS, BS/MS, PhD)
- Engineering Physics (BS)
- Computer Science (BS)
- Business (PhD)
- Aerospace (PhD)

Optimizing Honey Bee Foraging Yield through Efficient Waggle Dancing

(Richard Clancy, Liam Madden, Daniel Ferguson)

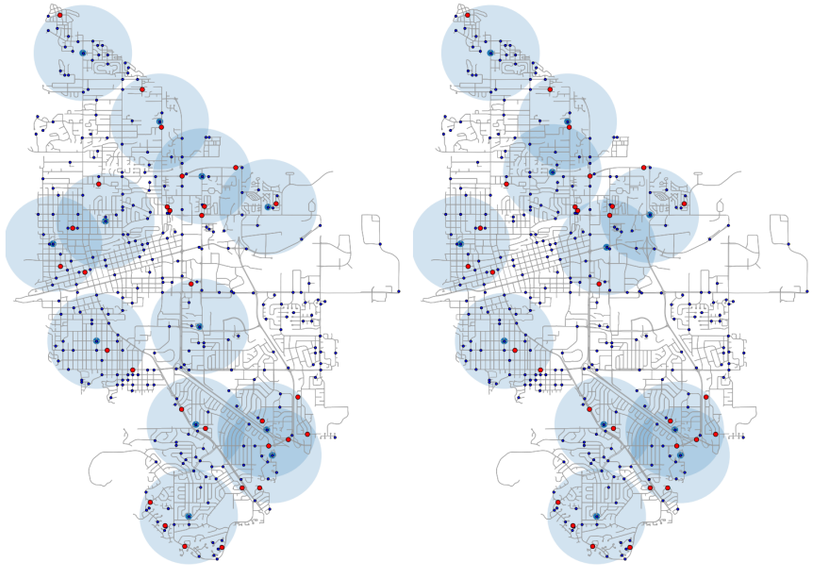
For our project, we investigated optimal parameter values to maximize the foraging yield of honey bees given two food sources. We solved the optimization problem via grid search, Nelder-Mead, a direct method, and the Adjoint State Method.





Set Covering in Boulder (for mothership/drone problem)

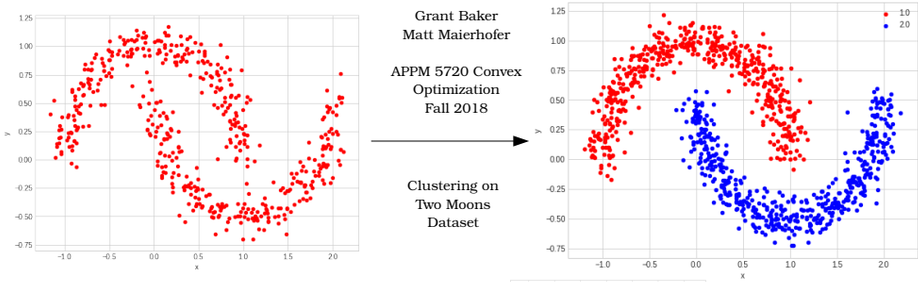
(Hasti Rahemi and Sam Zhang)



(a) Greedy (b) Branch & Bound

Support Vector Clustering

(Grant Baker, Matt Maierhofer)



- Use support vector machine infrastructure to find hypersphere to enclose all data in feature space
- If line between points is entirely within hypersphere, points are in the same cluster
- Naive algorithm slow, but possible speedup with stochastic gradient and reduction of number of points to check
- Performs well only with fine hyperparameter tuning