Estimation and Control of Periodic Orbits

Petr Listov
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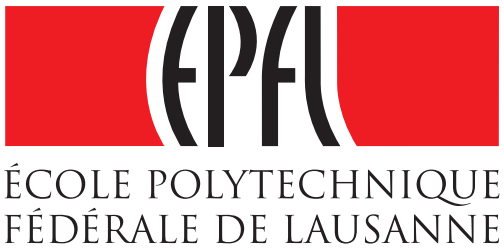

March 3rd, 2016

Outline

- Introduction
- Preliminary research objectives
- Key questions

Educational Background

- **Bauman Moscow State Technical University** [2006-2012]
- Department of Informatics and Control Systems
- Specialist in Automatic Control Systems for Flight Vehicles
- Thesis "Vision Based Navigation for Unmanned Aerial Vehicle"

Professional Experience

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RoboCV

(Loading Video...)

- Nonlinear Model Predictive Control (NMPC) for motion control of an Autonomously Guided Vehicles (AGV)
- Motion Planning algorithms development for an AGV
- Develoment of the robot pose estimation method based on augmented reality markers and camera

EPFL Contribution

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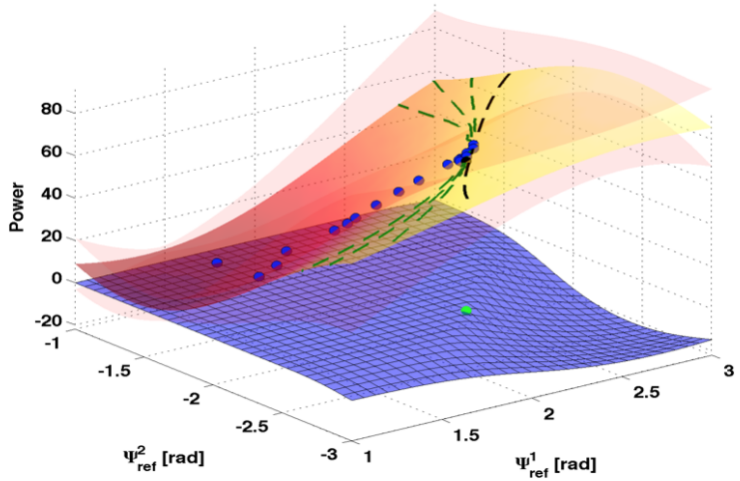
Gaussian Process (GP) Optimization



- Power output maximization based on Experimental Data
- Adaptive to changing exogeneous conditions
- Can handle Model Mismatch

[S. Diwale, A. Alessandretti, I .Lymperopolous, C. Jones]

EPFL Contribution

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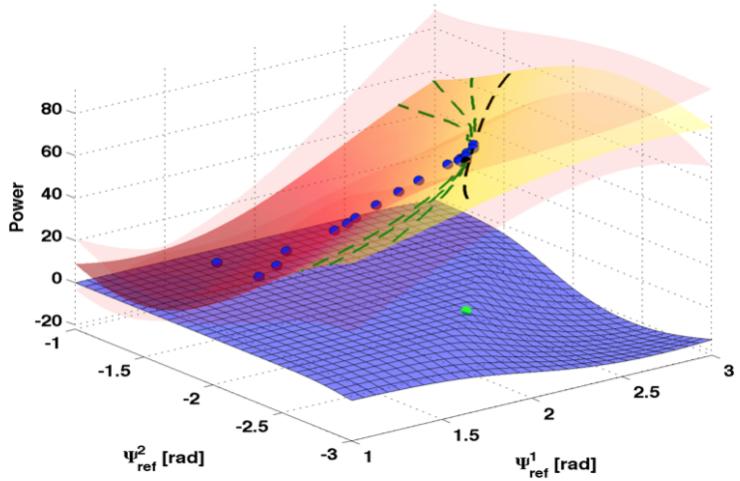
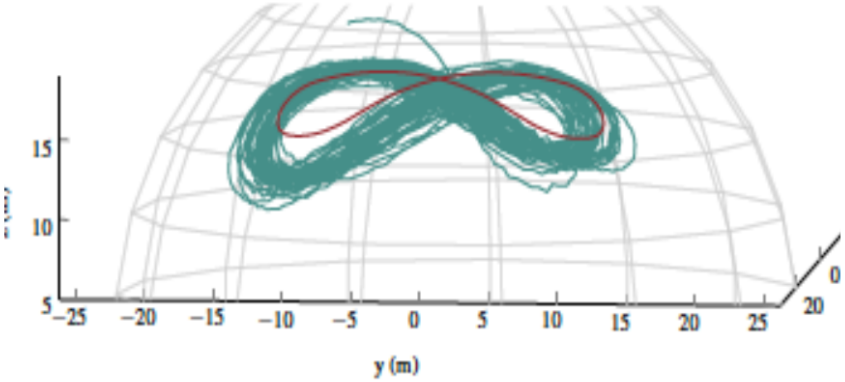
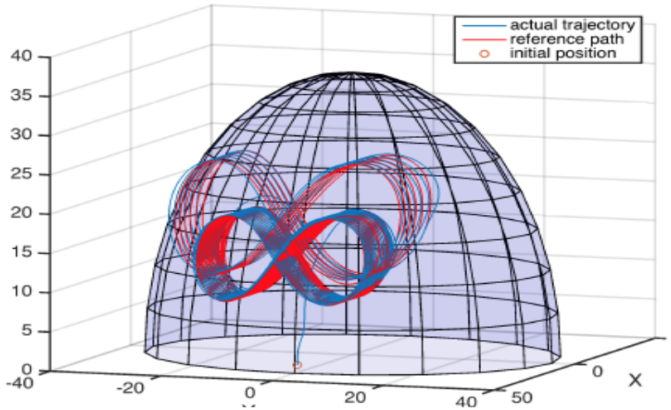


Delay Compensation



Adaptive Nonlinear Control



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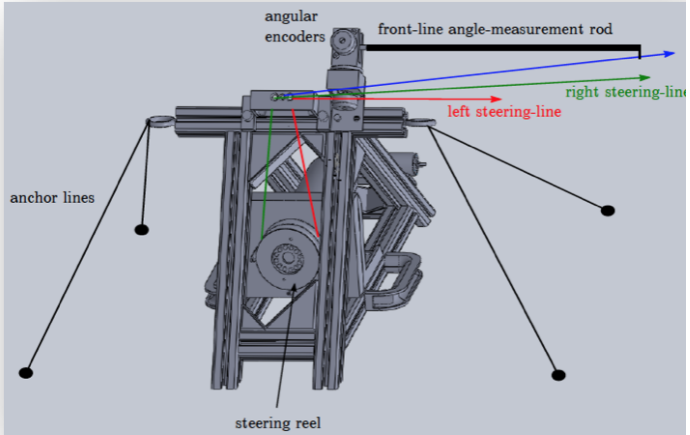
Experiments at EPFL



Fixed Line Length Ground Station

- Three Line Kites
- Two sizes currently supported (2.5 m^2 and 3.5 m^2)
- Integrated with Matlab
- GP optimization implemented

Speedgoat + Flavio Simulator

- Real Time Capabilities
- Matlab to Speedgoat Interface
- Realistic Simulation Testbed

Preliminary research ideas

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General motivation:

- **Developing novel methods for state estimation and control of a kite for robust flight with high uncertainties and changing exogeneous conditions.**

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Possible research directions:

- Real time nonlinear model predictive control for trajectory tracking
- Data driven control and estimation techniques;
- Fast uncertainty propagation methods for state estimation;

Testing platform development

- The new [20x20x10] meters facility at the EPFL equipped with a 6DoF vision-based tracking system

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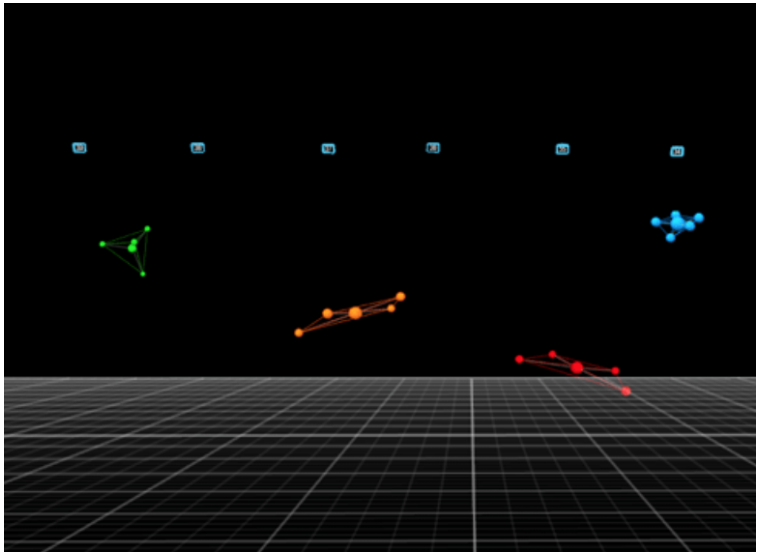
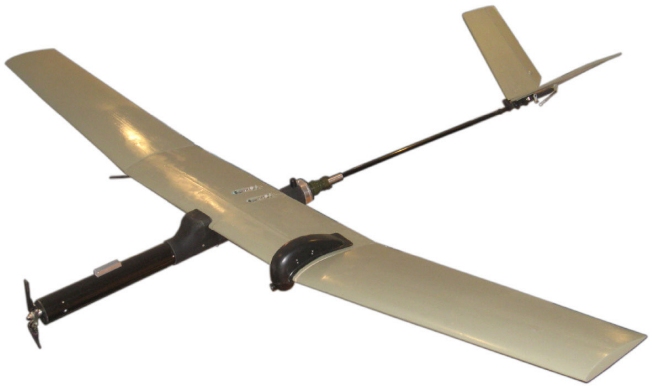


- Tracking system characteristics:
+ Positional error is less than $0.3mm$;
+ Rotational error less than $0.05°$
+ Allows high-speed UAV tracking

Testing platform development



- Glider
- Powered by propeller
- On-board control and navigation computation
- Traction force measurement on a ground station

Questions

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Key questions to answer at this point:

- Is it possible to transfer lessons learned from a device that has no wind and an on-board propeller, to one that doesn't?
- How close can we get the dynamics to be when driving it with a propeller?