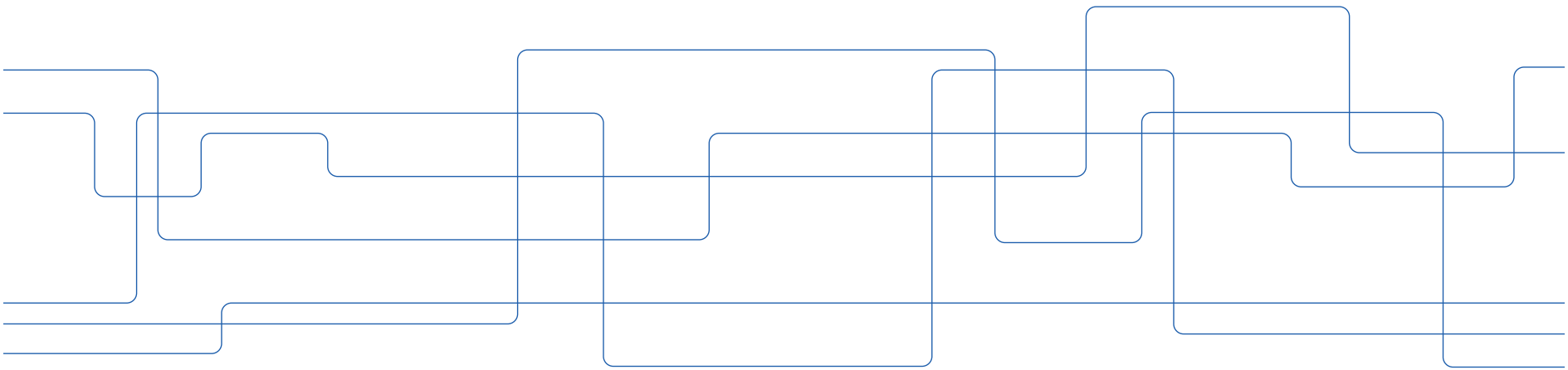
Predictive Safety Filter for Learning Controllers during Path Following

John Liu[1]

[1]Einride Master's Thesis Program

2022-06-16



Outline

- Introduction
  - Research Problem
- Background
  - Vehicle Model
  - Gaussian Process Regression
  - Model Predictive Control
  - Predictive Safety Filter
  - The Basic Problem That We Studied
  - Previous Work
- Results
  - Swing-up Pendulum
  - Vehicle Path Following
  - Main Results
  - Basic Ideas for Proofs/Implementation

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Model-based Controllers

Control Theory

- Model-based controllers make assumptions about the vehicle dynamics and the external environment.

Learning Controllers

Machine Learning

- Learning controllers have a greater performance potential but lack safety guarantees.

Problem Formulation

- Can a predictive safety filter ensure safety when it is not possible to fully model the real system dynamics?

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- Can a predictive safety filter ensure safety when it is not possible to fully model the real system dynamics?
- Specifically, can predictive safety filter guarantee safety for the Einride pod during a path following task?

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Kinematic Model

Dynamic Model

Frenet Frame

A coordinate system transformation

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Make Titles Informative. Use Uppercase Letters.

Subtitles are optional.

- Use `itemize` a lot.
- Use very short sentences or short phrases.

Make Titles Informative.

You can create overlays...

- using the `pause` command:
  - First item.

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You can create overlays. . .

- using the `pause` command:
  - First item.
  - Second item.
- using overlay specifications:

- using the general `uncover` command:

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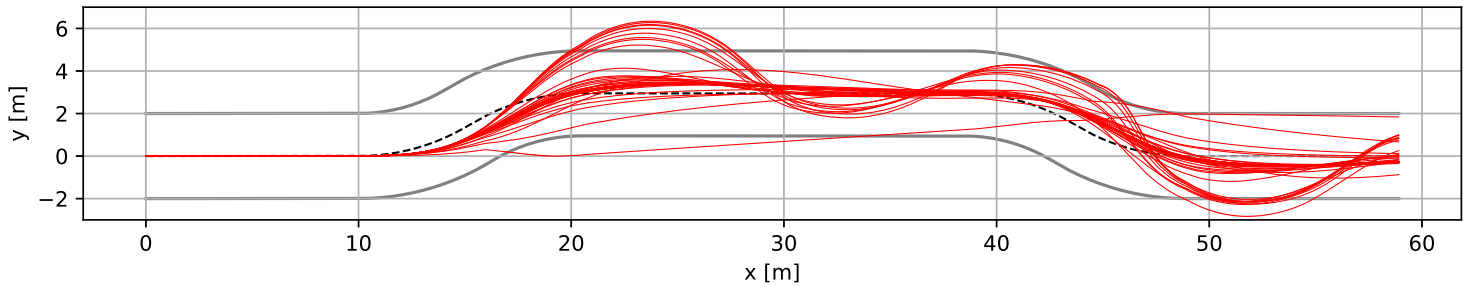
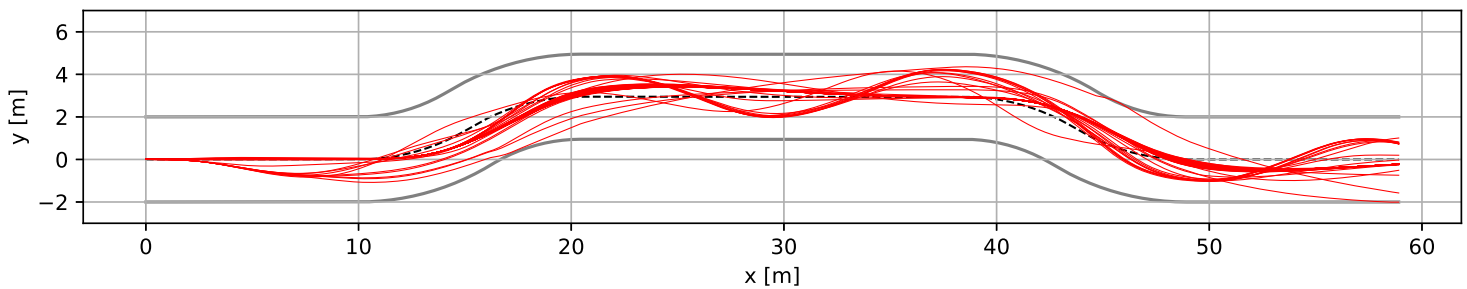
- Unsafe system:



- Safe system:



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Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.

For Further Reading I

A. Author.
Handbook of Everything.
Some Press, 1990.

S. Someone.
On this and that.
Journal of This and That, 2(1):50–100, 2000.