Semantics of Optimization for Real Time Intelligent Embedded Systems (SORTIES)

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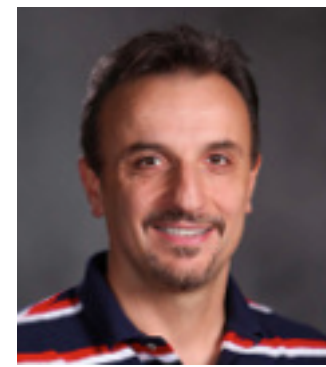
Description

high-level major purpose of the work:

- **Proof-Carrying automatic code generation**:
  - Semantics: Identify semantics associated with embedded, real-time optimization algorithms
  - Front-end: proof-carrying autocoder that implements convex optimization algorithms and their semantics
  - Back-end: Analyzer to demonstrate that the output of the autocoder is indeed analyzable, and provably correct.
- Floating-point arithmetic management

- Demonstrate the relevance and feasibility of embedding modern optimization (and control) algorithms in real-time applications, with strong theoretical guarantees.

Findings

- Implemented autocoder that generates C code implementation of both Ellipsoid Method and Interior-point method (primal-dual).
- Generating proof along with code as annotations.

- Modifying the Ellipsoid Algorithm to account for the floating-point errors:
  - Widen the Ellipsoids
  - Adding a step controlling the condition number of the Ellipsoids
- Successfully shown stability for sequential optimization problems (MPC).
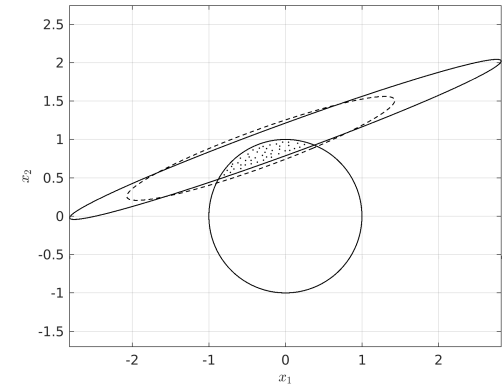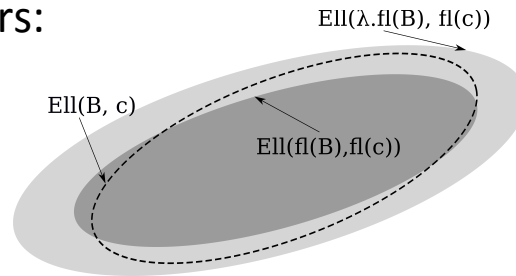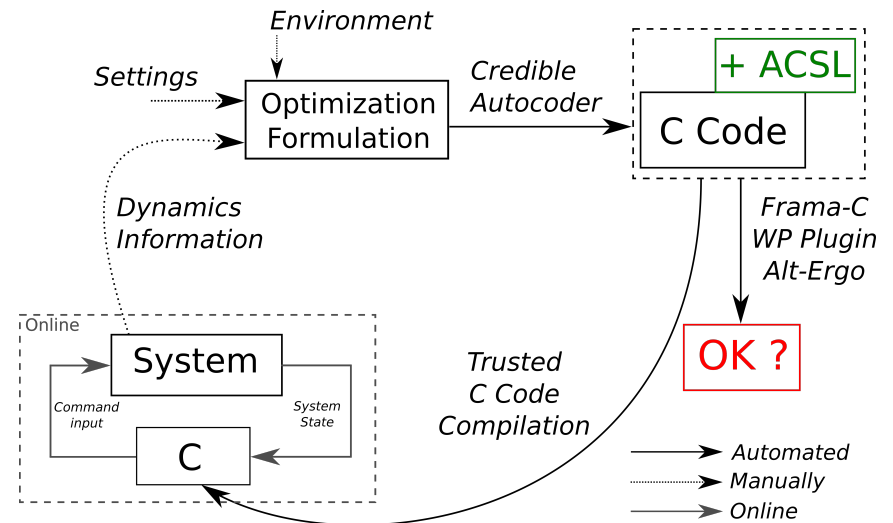
Output :
- "Credible Autocoding of Convex Optimization Algorithms". *Optimization Engineering*
- *"*Validation of Convex Optimization Algorithms and Credible Implementation for Model Predictive Control*". SCITECH 2017*
- "Formal Verification for Embedded Implementation of Convex Optimization Algorithms". *IFAC 2017*
- **Online CPS course offered by Georgia Tech's OMSCS**