Autonomous Mobile Robotics

What to do next

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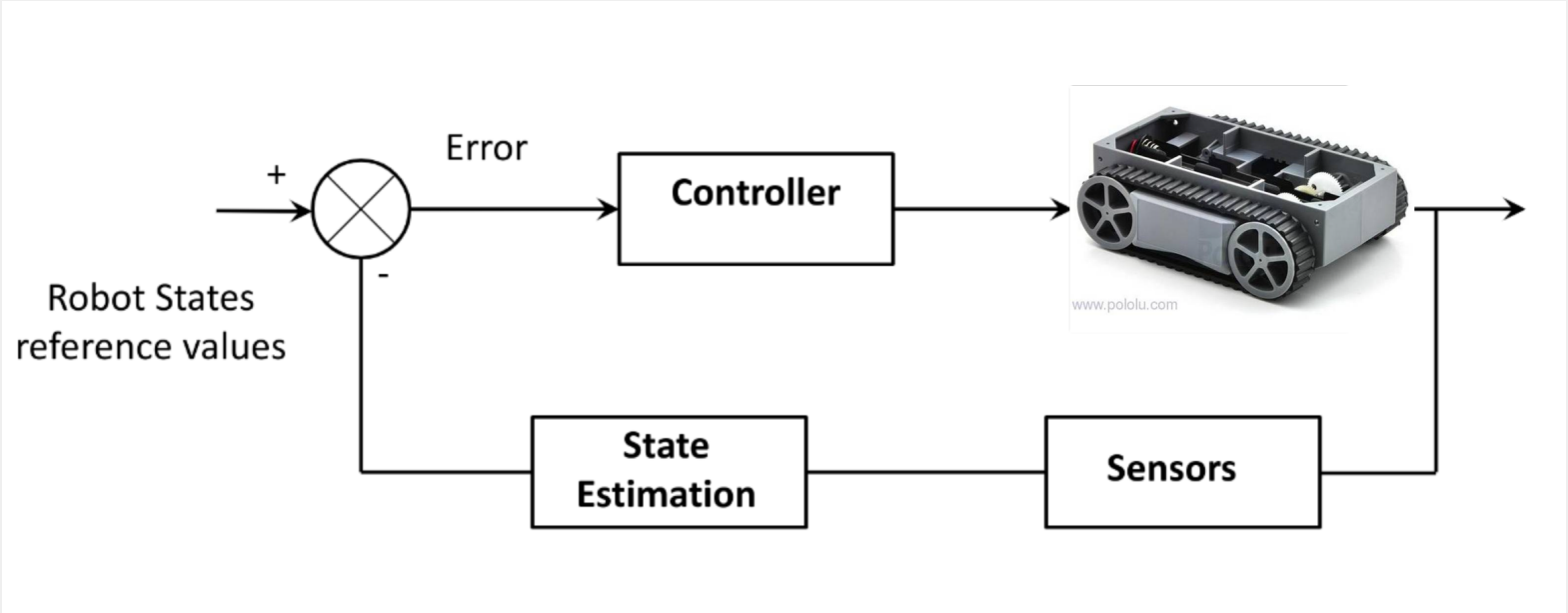
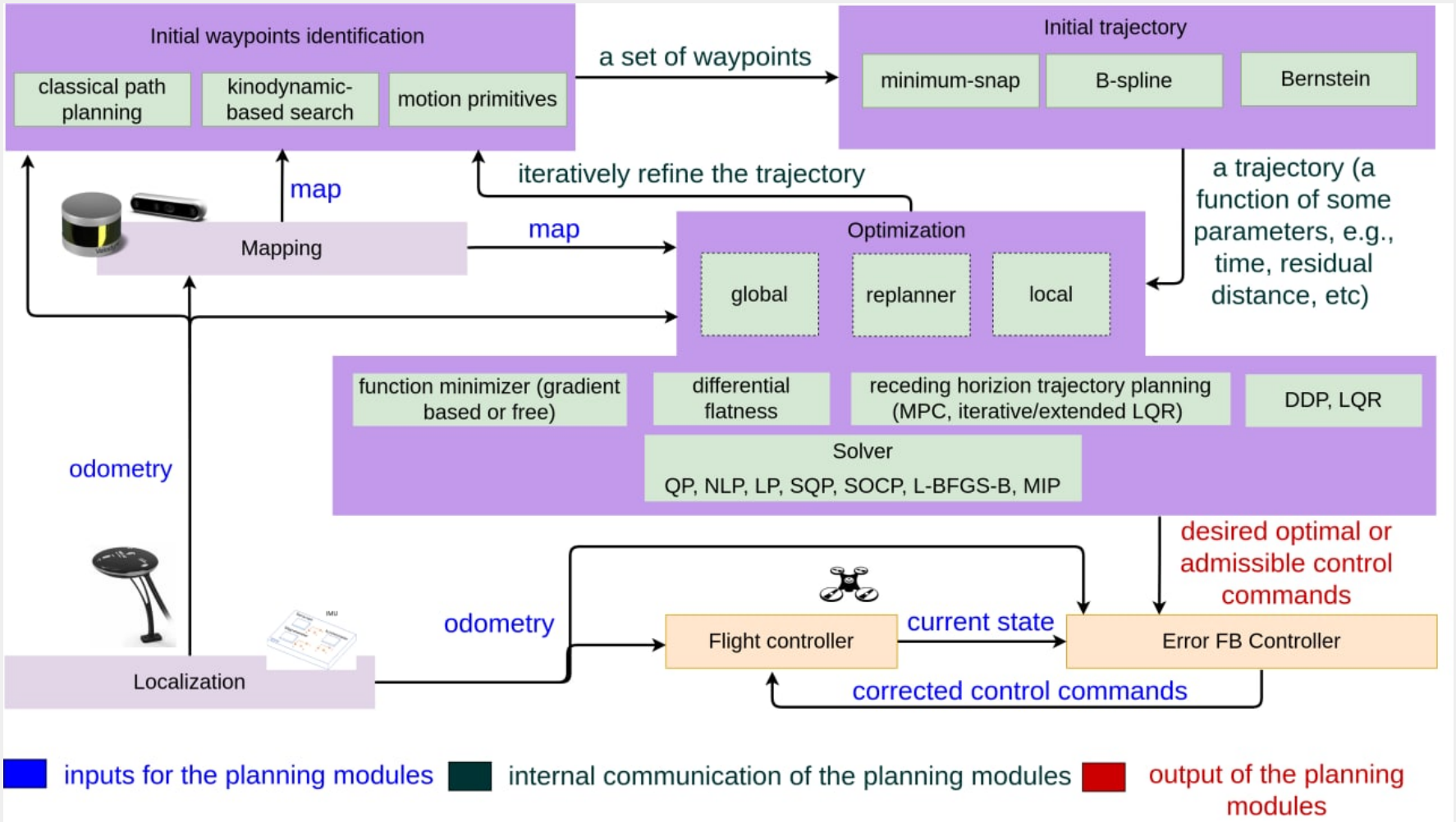
Introduction

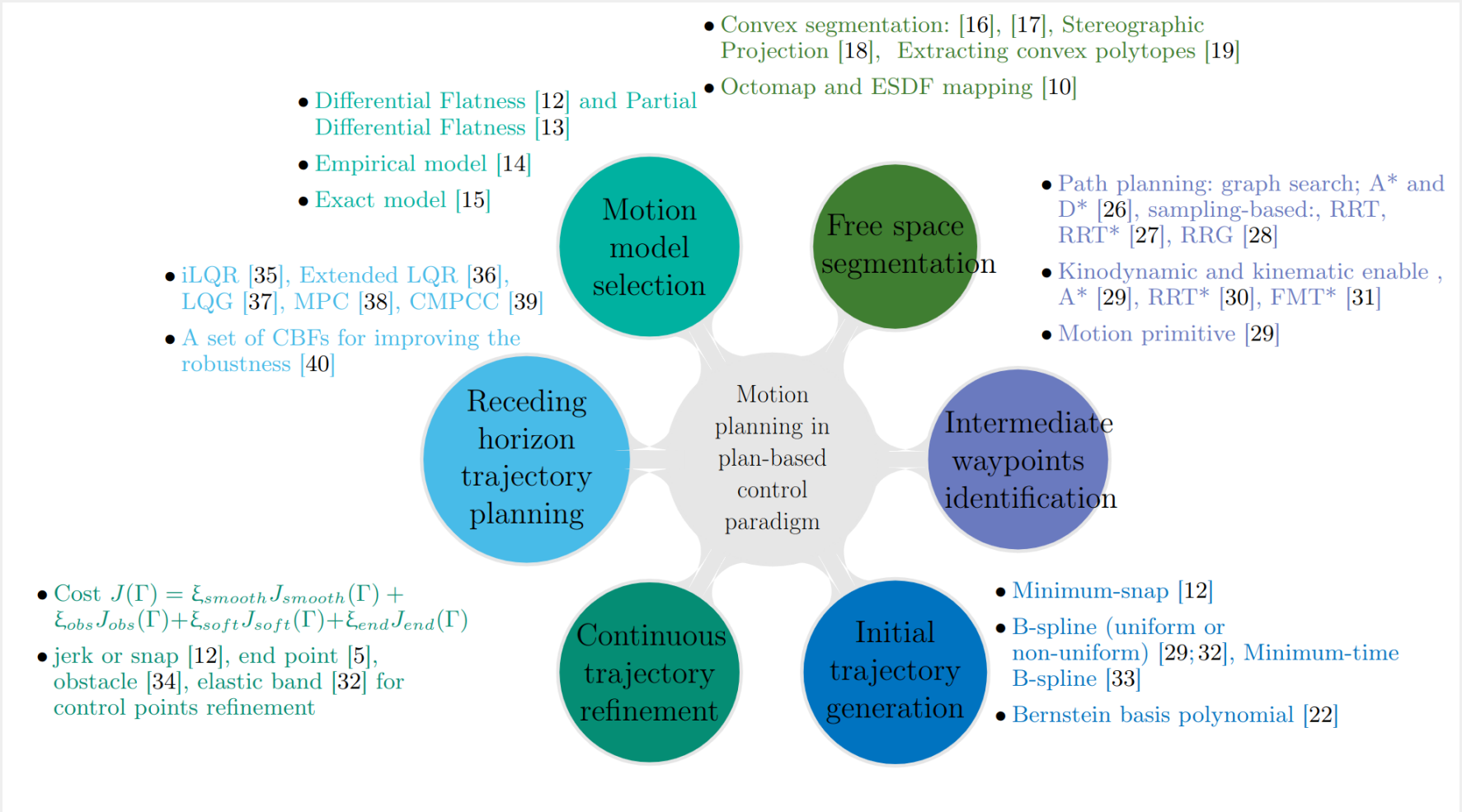


Trajectory planning

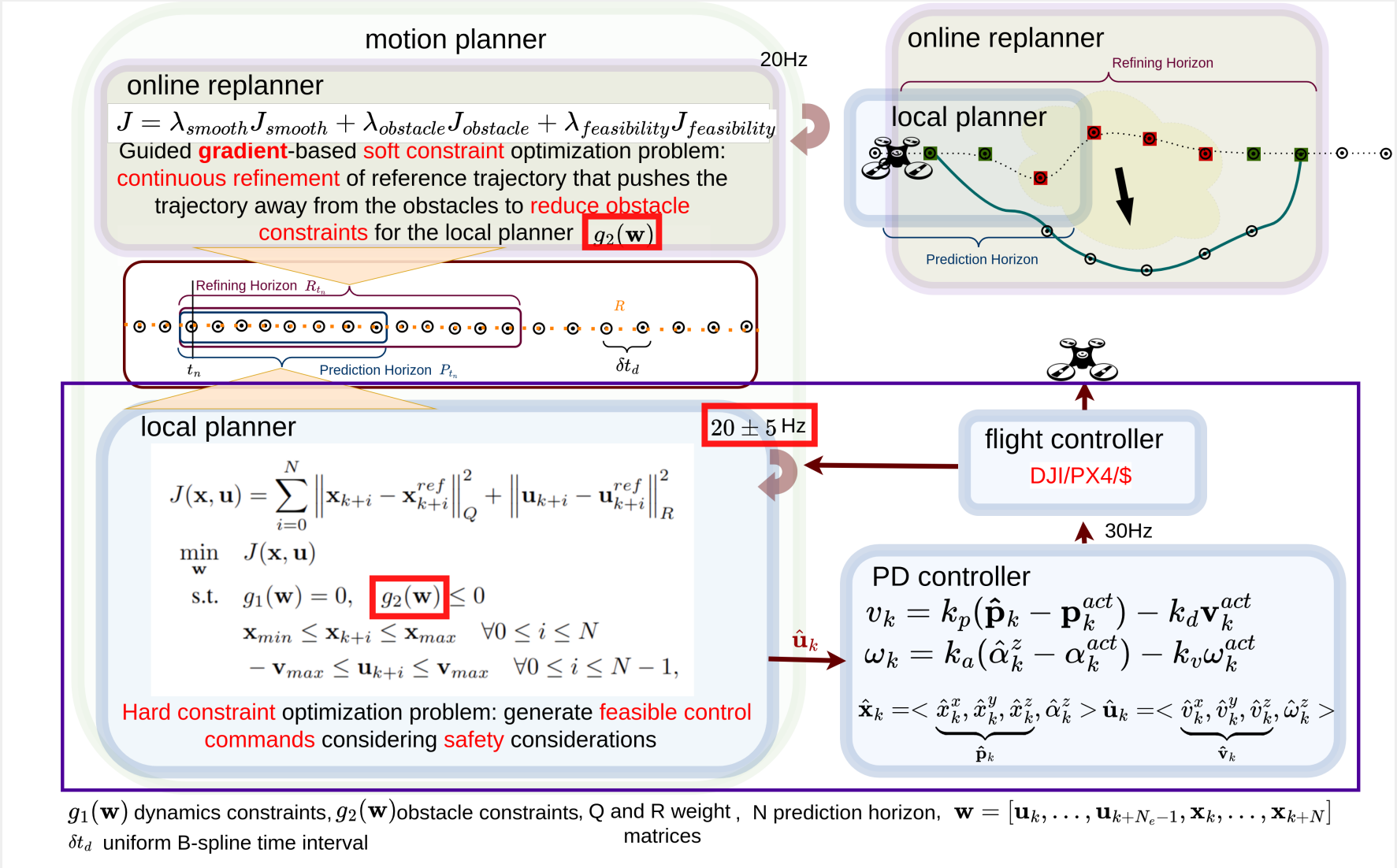


The overview of plan-based control paradigm in the context of trajectory planning problem formulation. There are various ways to formulate the trajectory planning problem, each of which consists of a set of sub-modules (green colour boxes) depending on the problem behaviour

Trajectory planning in the plan-based control paradigm



Example of a motion planner

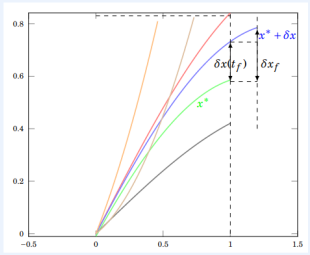


$g_1(\mathbf{w})$ dynamics constraints, $g_2(\mathbf{w})$obstacle constraints, Q and R weight matrices, N prediction horizon, $\mathbf{w} = [\mathbf{u}_k, \ldots, \mathbf{u}_{k+N_e-1}, \mathbf{x}_k, \ldots, \mathbf{x}_{k+N}]$

δt_d uniform B-spline time interval

Trajectory planning in the plan-based control paradigm

Variation of calculus



Trajectory generation

linear, nonlinear, or piecewise,

- n degree
- Lagrange
- Quintic
- Spline interpolation: Linear, Quadratic, and Cubic Spline
- Bezier
- B-spline
- Smoothing using gradient descent
- Double arc trajectory interpolation

Path Planning

Graph-based

- Depth First Search
- Breath First Search
- Dijkstra's Algorithm
- Greedy Best First Search
- A*
- Hybrid A*
- Kinodynamic A*

Sampling-based

- PRM
- RRT
- RRT*

Optimal Control Problem
(boundary value fixed and varies)

point and differential equations constraints

control constraints

Hamiltonian

Pontryagin's Minimum Principle

Quadratic Programming (QP)

Mixed-integer QP

Nonlinear Programming (NLP)

Model Predictive Control

. Multiple-Shooting
. Direct-Collocation

planning: optimal tracking and regulating

controlling: path tracking control

Frenet frame trajectory planning

Linear Quadratic Regulator

Least squares

Hamilton Jacobi Bellman (HJB)

optimal tracking and regulating

Model

discrete
continuous

linear
nonlinear
linearaized

time-varying
time-invarient

https://github.com/GPrathap/motion_planning


THANK
YOU