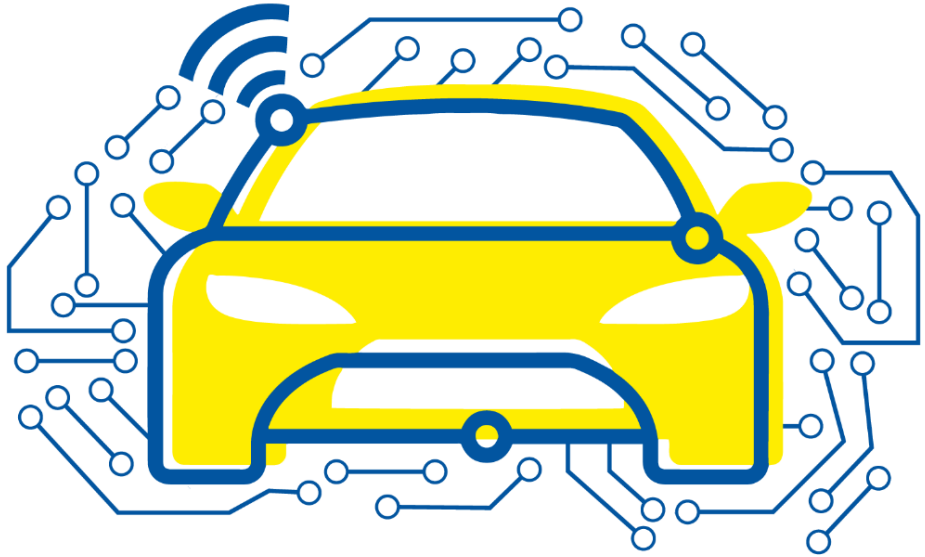
Automated and Connected Driving Challenges

Section 4 – Vehicle Guidance

Vehicle Guidance on Guidance Level

Introduction



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Vehicle Guidance

Fundamentals – Optimal Control Problem

The Goal of Motion Planning:
Transition of a system from a start-state $\mathbf{x}_0$ to a goal-state $\mathbf{x}_f$.

The optimal control-problem is defined by:

The system dynamics:

$$\dot{\mathbf{x}}(t) = f(\mathbf{x}(t), \mathbf{u}(t), t)$$

$$\mathbf{x}(0) - \mathbf{x}_0 = 0$$

Additional boundary conditions:

$$g(\mathbf{x}(t_f), t_f) = 0$$

Source: Werling 2017

Vehicle Guidance

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$$g\big(\mathbf{x}(t_f), t_f\big) = 0$$

$$h(\mathbf{x}(t), \mathbf{u}(t), t) \leq 0 \quad \forall\, t \in [0, t_f]$$

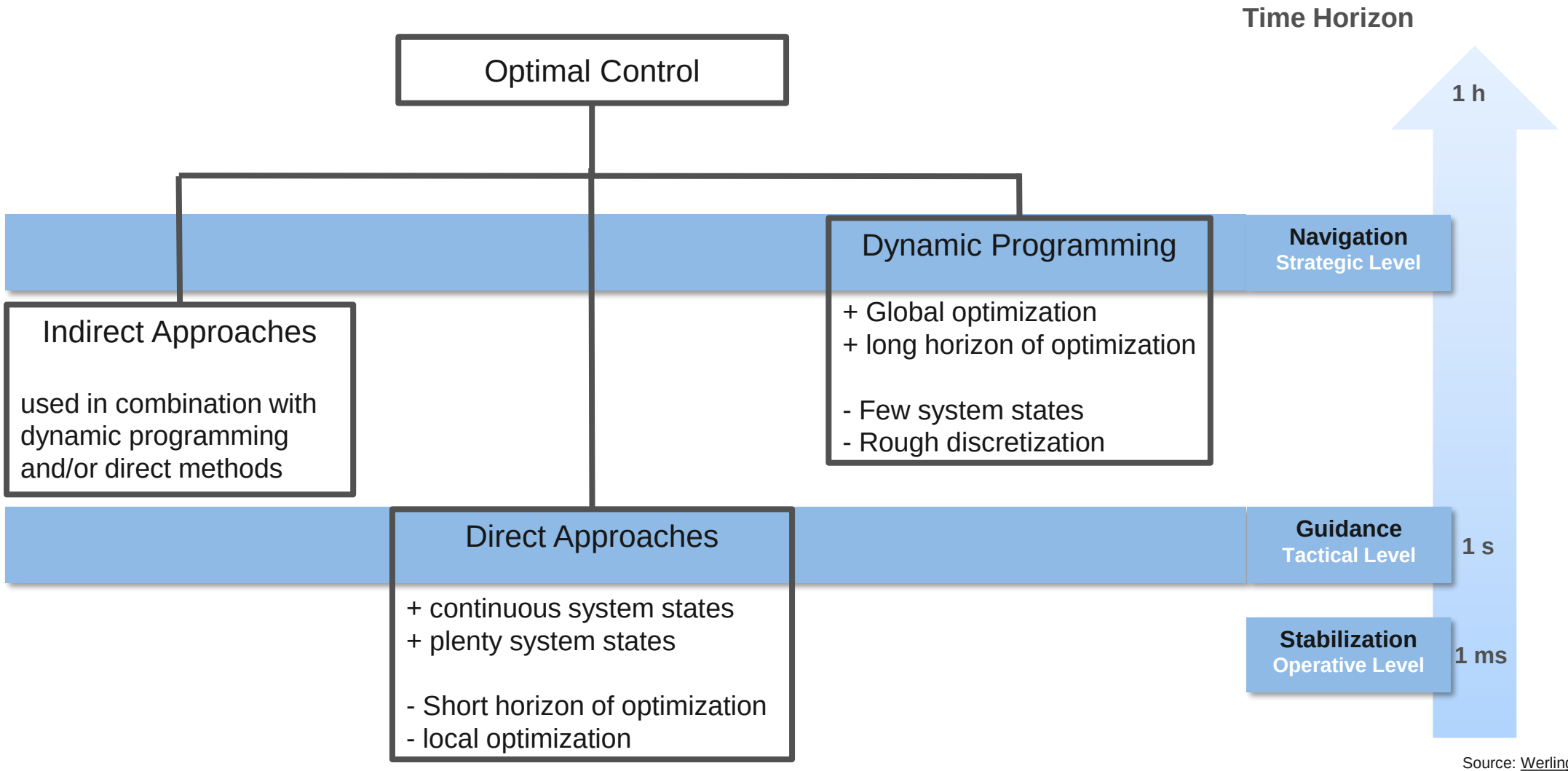
The cost function:

$$\min_{\mathbf{u}} J\big(\mathbf{x}(t), \mathbf{u}(t)\big) = \int_0^{t_f} l(\mathbf{x}(t), \mathbf{u}(t), t)\, dt + V(\mathbf{x}(t_f), t_f)$$

Source: Werling 2017

Vehicle Guidance

Fundamentals – Approaches to solve the OCP



Source: Werling 2017

Vehicle Guidance

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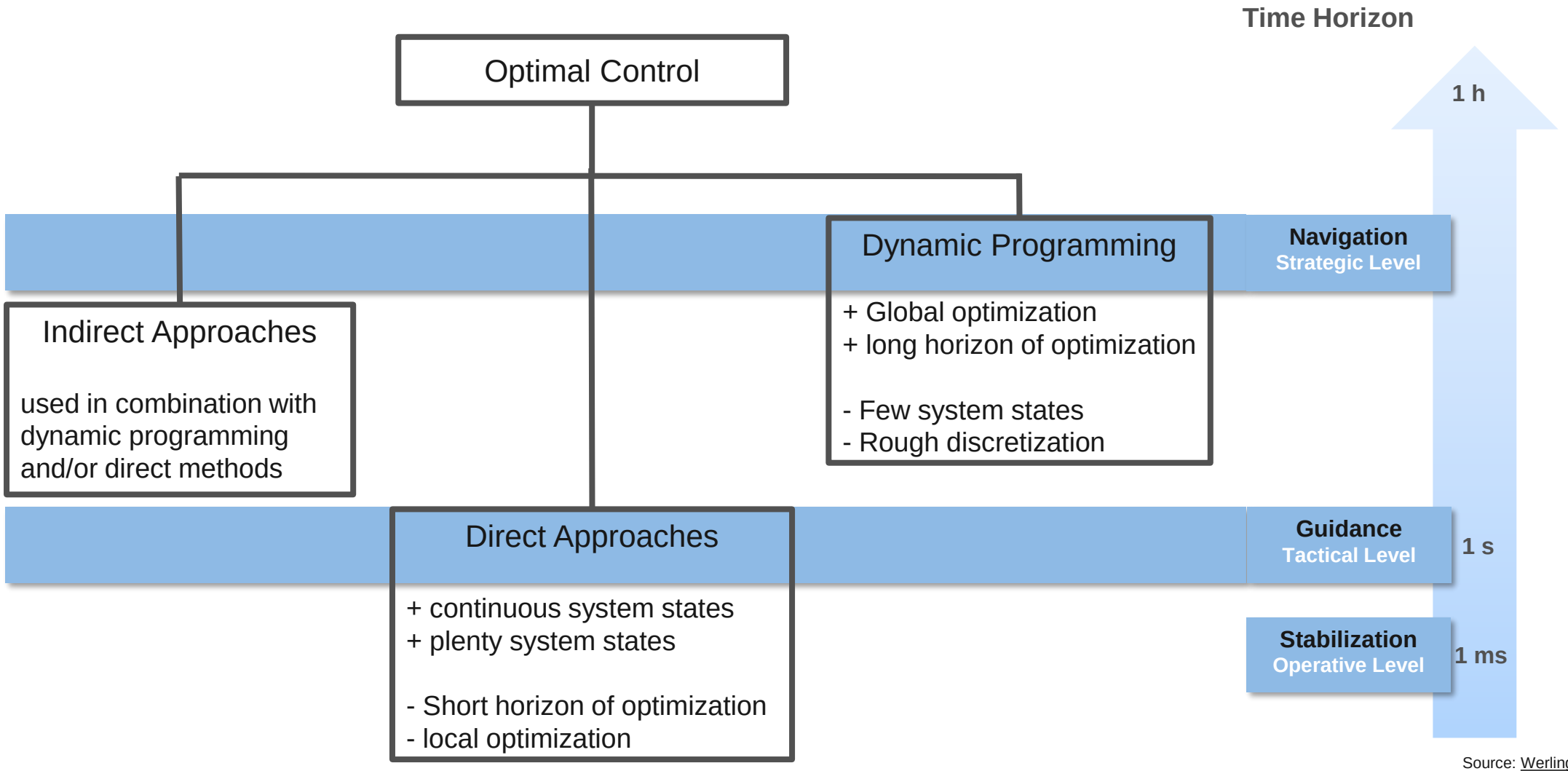

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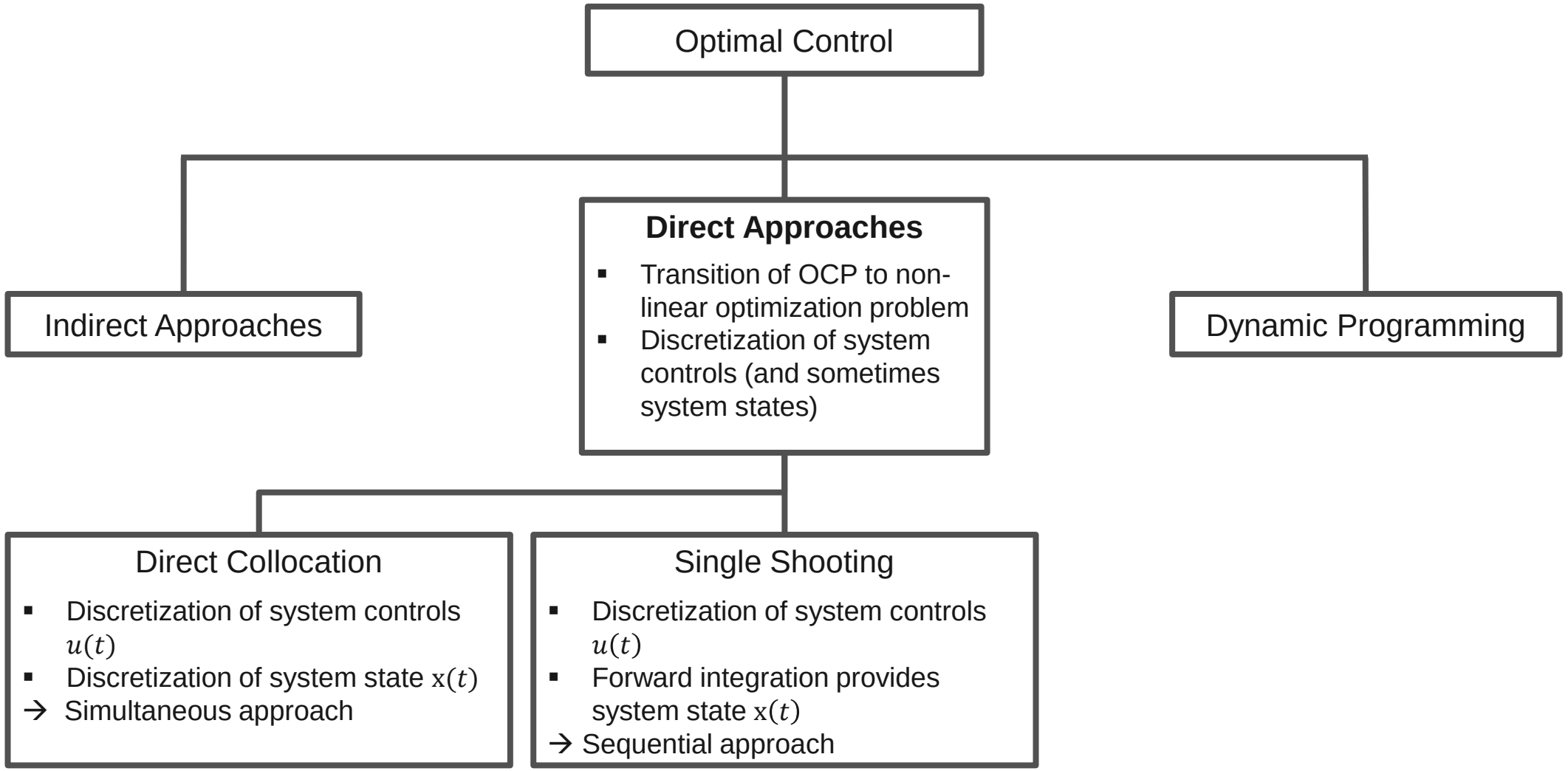
Vehicle Guidance on Guidance Level

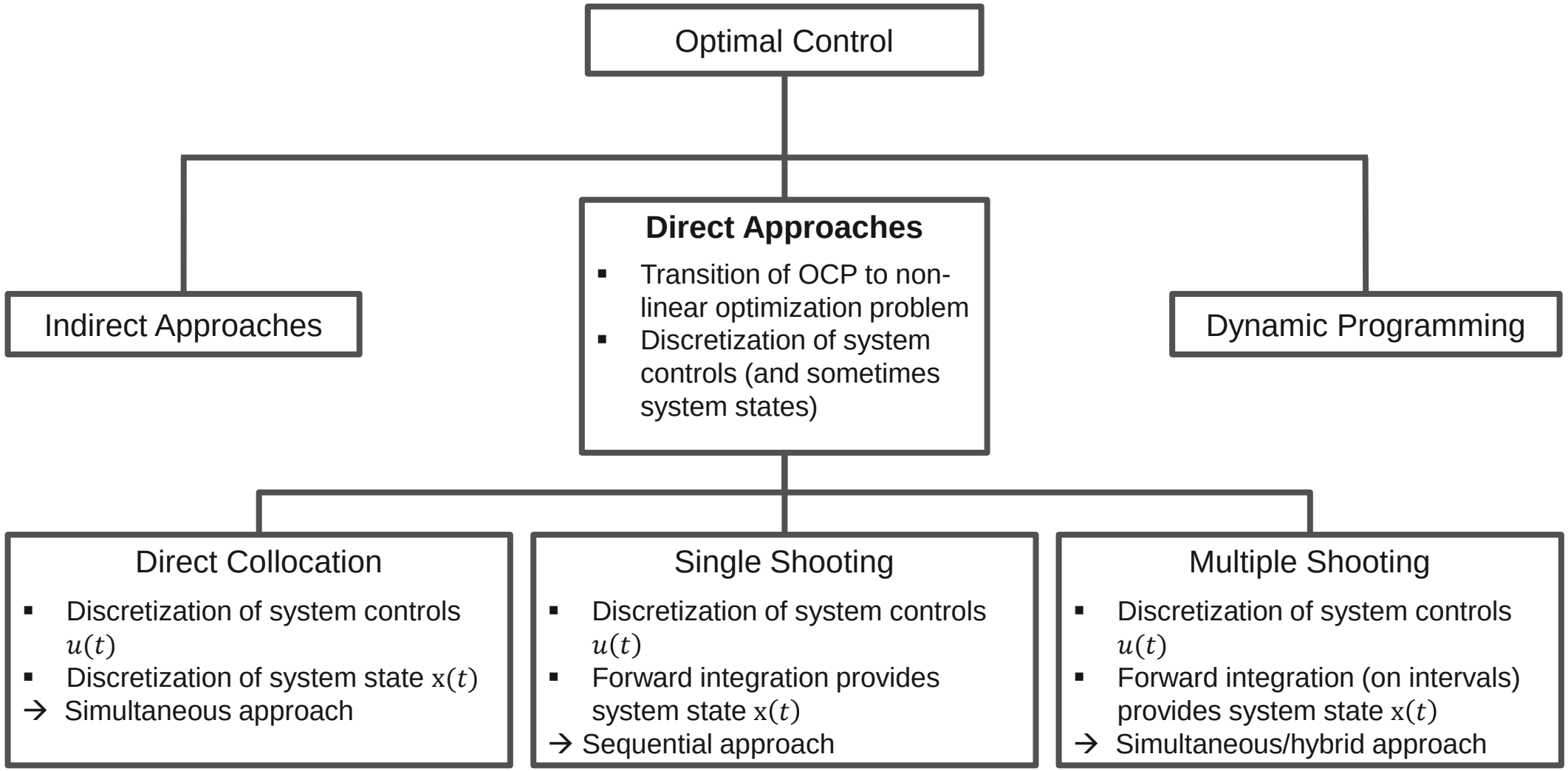
Categorization of Direct Approaches



Source: Diehl et al. 2006

Vehicle Guidance on Guidance Level

Categorization of Direct Approaches



Source: Diehl et al. 2006