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PHEV Control Strategy Assessment Through Optimization

DOE Merit Review
28 February, 2008

D. Karbowski, S. Pagerit, P. Sharer, A. Rousseau
Argonne National Laboratory
Sponsored by Lee Slezak

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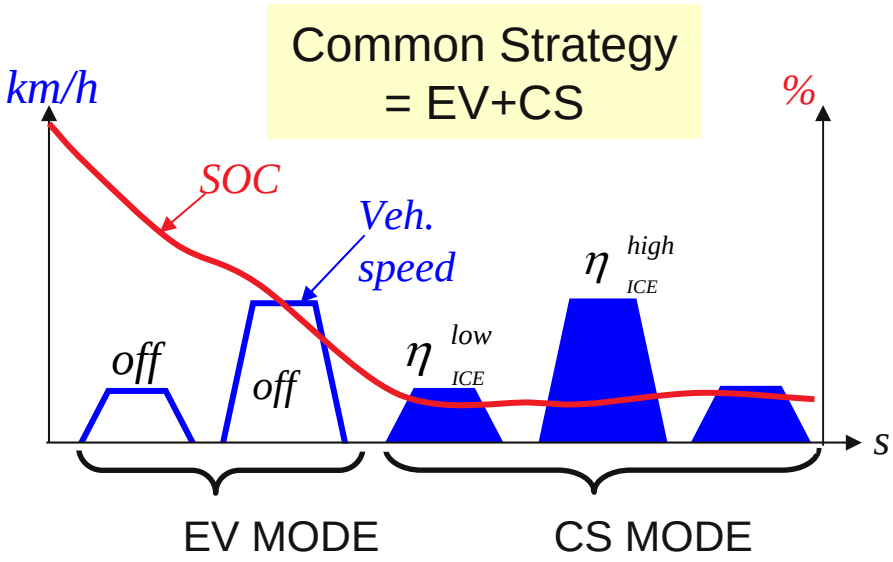
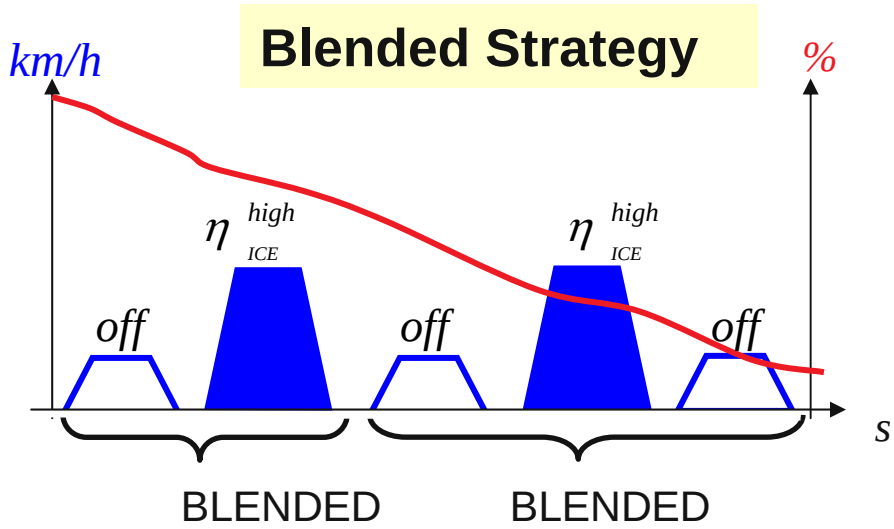
Objective: Assess Fuel Displacement Potential of Various PHEVs Control Strategies

Higher Electric Energy
Higher Electric Power
→ Higher Control Freedom → **Fuel Savings Potential**

- Depending on various driven distance, several modes are possible during charge depleting: Electric-only (EV) and Blended

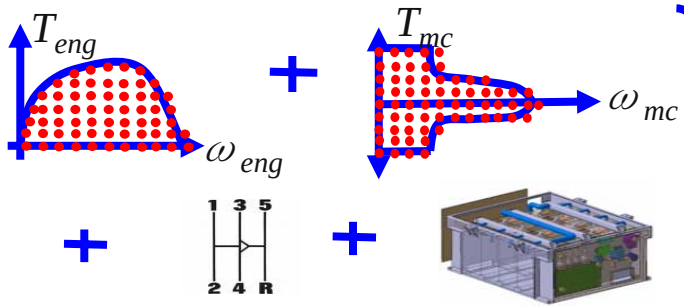




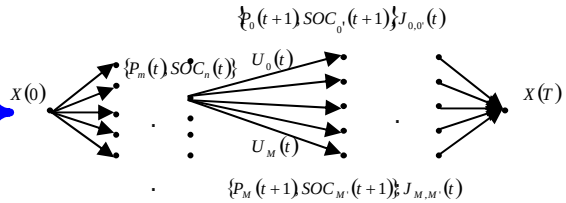
Optimization Evaluates Control Strategy's Potential

Innovative 3-Way Approach to Control Optimization

Global Optimization



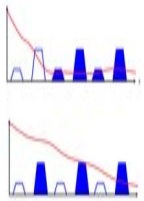
Backward model (not PSAT)



Bellman Principle

⇨ Optimal Control, Minimal Fuel Cons.

Control Design



Various Control Principles

PSAT +

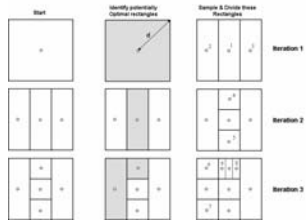
Rule-Based Control Design

⇨ Various PSAT Control Strategies

Heuristic Optimization

PSAT +

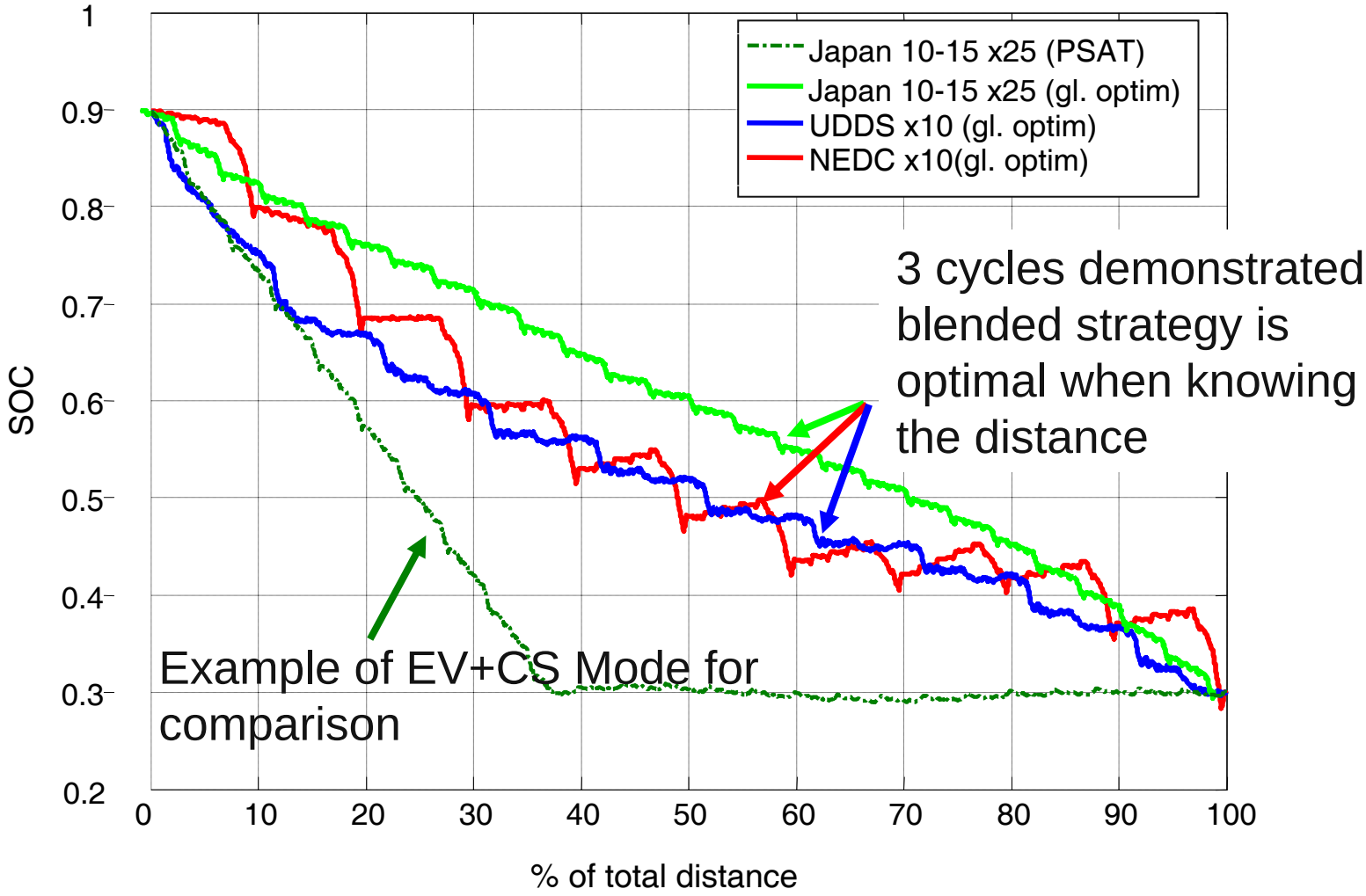
Existing Control Logic



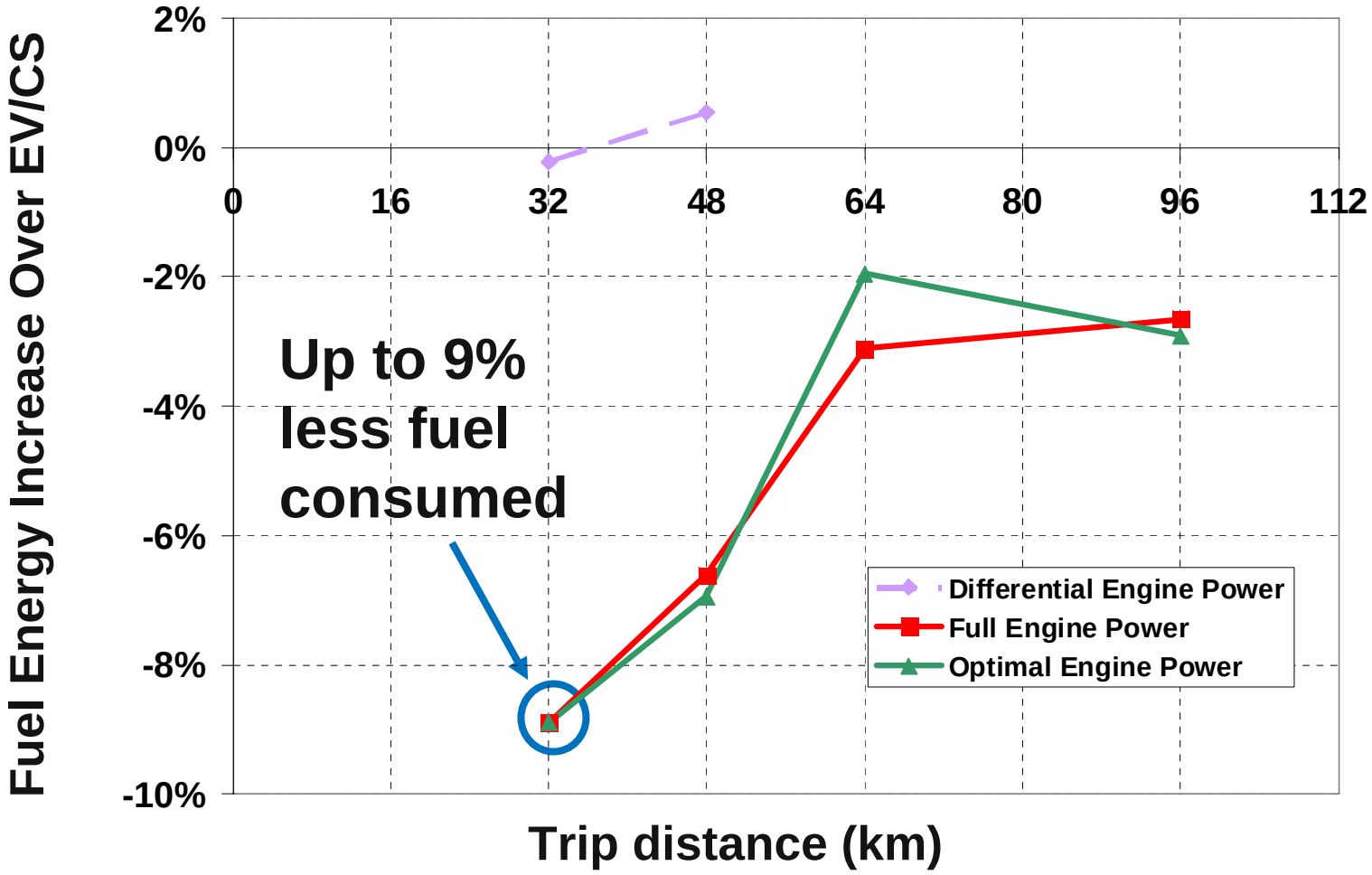
DIRECT Algorithm

⇨ Optimally tuned Parameters

Global Optimization Showed Minimal Fuel Consumption Achieved in Blended Mode



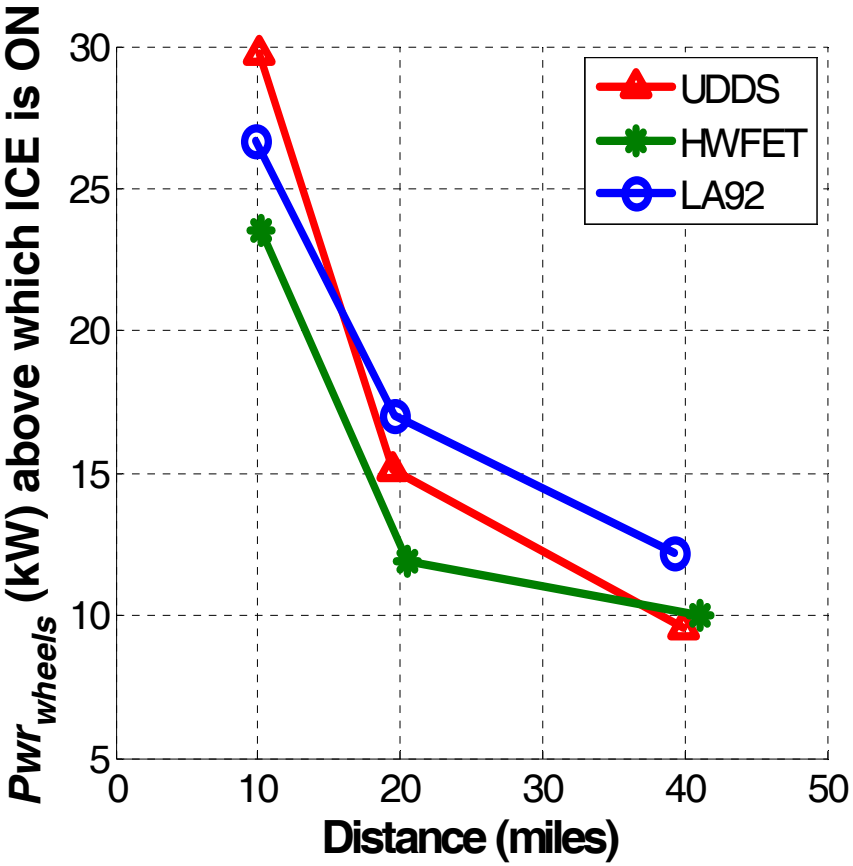
Blended Control Strategy Design Showed Significant Improvements Over EV Mode



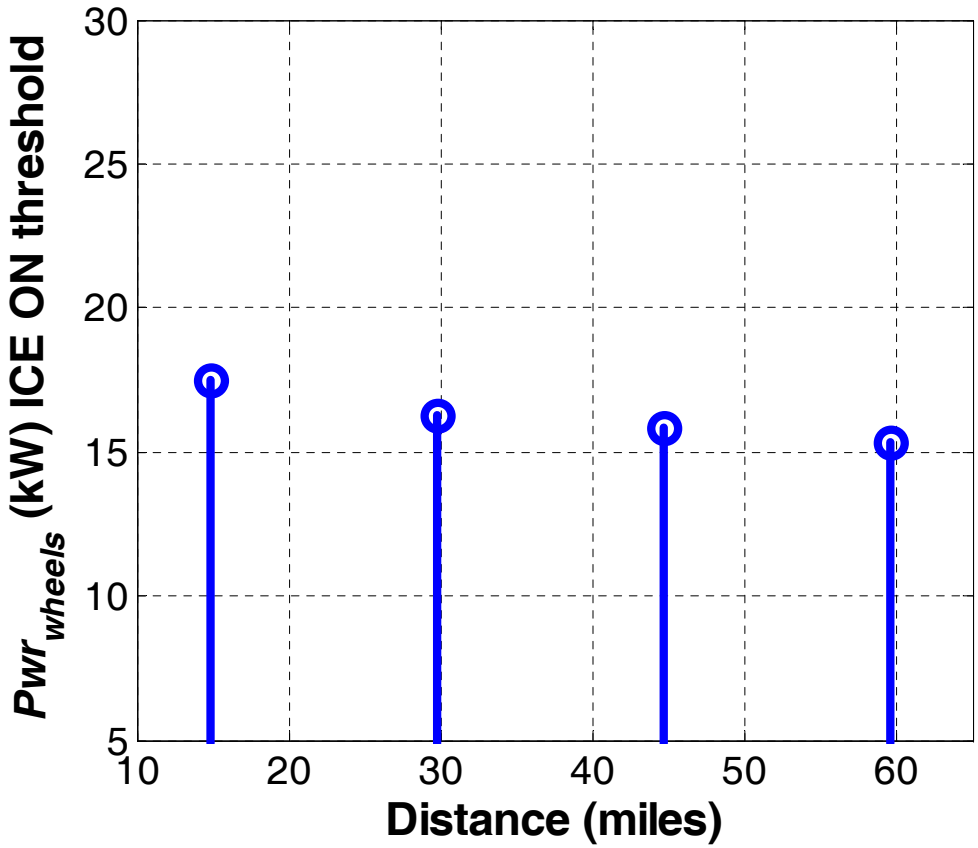
10 miles AER vehicle run on several UDDS cycles

Different Optimization Methods Showed Control Depends on Distance

Global Optimization



Heuristic Optimization (UDDS)



10 miles AER vehicle

Control Strategy Assessment Provided Insights on PHEVs Optimal Operations

- When the trip distance is greater than the All Electric Range, using the engine throughout the trip (blended control) is preferable to depleting the battery as fast as possible
- Optimum control depends on the distance
- Engine On/Off is linked to wheel power demand and available electrical energy
- When used, engine should be operated at high efficiency

Future Work

- Further development of the optimization methods

→ ***To get a better understanding of the differences between each method***

- Implement power-split and series configuration in the global optimization algorithm

→ ***Establish a "fair" comparison of various hybrid configurations and investigate the influence on PHEVs energy consumption***

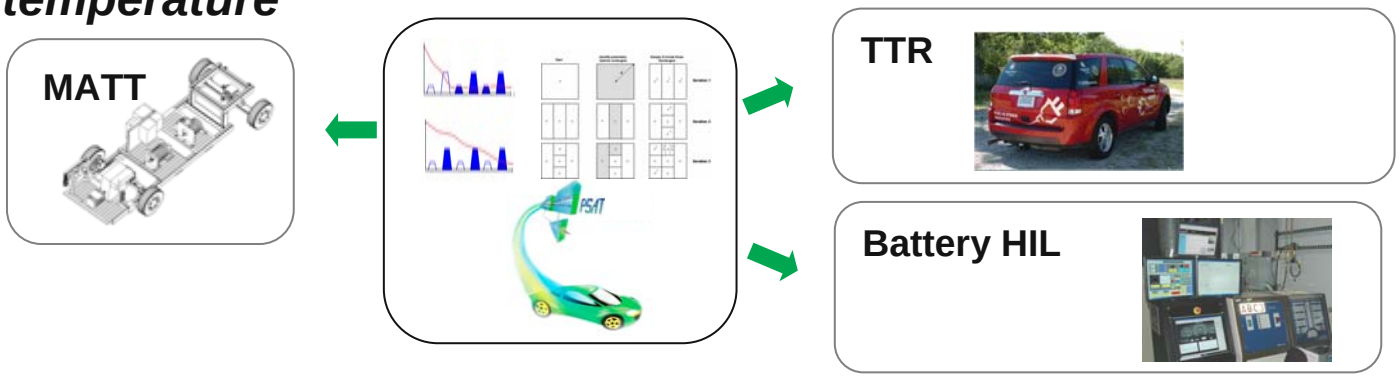
- Design a "smart" PSAT controller integrating results from optimization

→ ***Demonstrate the translation of potential gains into real-world gains***

→ ***Collaborate with an OEM***

- Implement optimized PSAT controllers on the MATT platform

→ ***Evaluate the influence of optimized controls on emissions and temperature***



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