AI Tools for Automotive

January 15th, 2021

PSO in the Optimal Design and Coefficient Tuning of Electrified Vehicles

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Agenda

01

Introduction

Brief introduction on Evolutionary Algorithms (EAs) and PSO

02

Problem Definition

Explanation of the scenario in which PSO is to be applied

03

PSO Application

How the PSO has been applied to the problem

04

PSO Results

Short visualization of the results brought up by the PSO up to now

Introduction

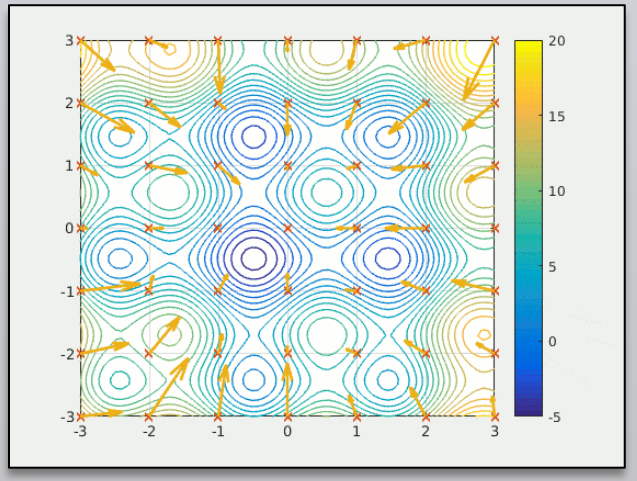
Evolutionary Algorithms Definition

- **Population-based metaheuristic optimization** algorithm;
- Inspired by **biological evolution**

Particle Swarm Optimization

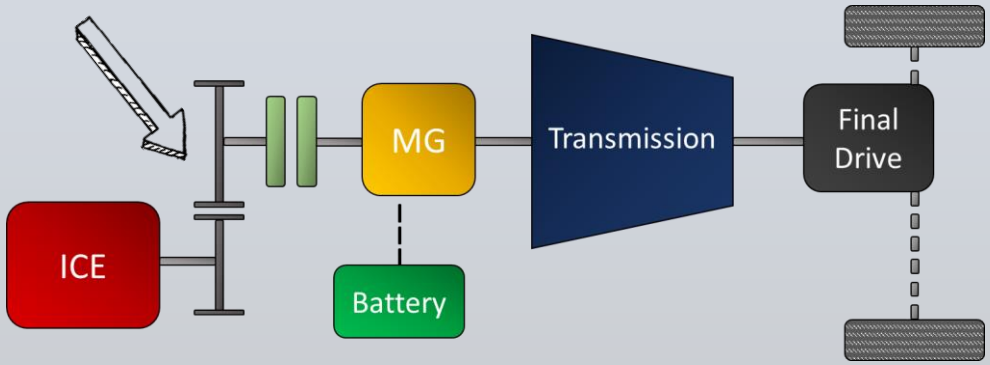
- Originally attributed to **Kennedy, Eberhart and Shi;**
- Born by the observation of the movement of organisms in a **bird flock** or **fish school**

Individuals searching for the minimum value in a function, PSO example



*Problem Definition, Designing and Testing a **HEV***

Gear between ICE and MG



7 unknown variables to be swept in the design process

Size of the Battery pack: ***2.1 kWh***

*Problem Definition, Designing and Testing a **HEV***

Driveability Assessment

Test the ability of the vehicle to drive at various speeds with different road slopes

0 – 100 km/h Time

Assess the acceleration performance of the vehicle

Fuel Consumption Test

Assess the fuel consumption of each candidate by running different real world drive cycles (obtained using **GPS**)

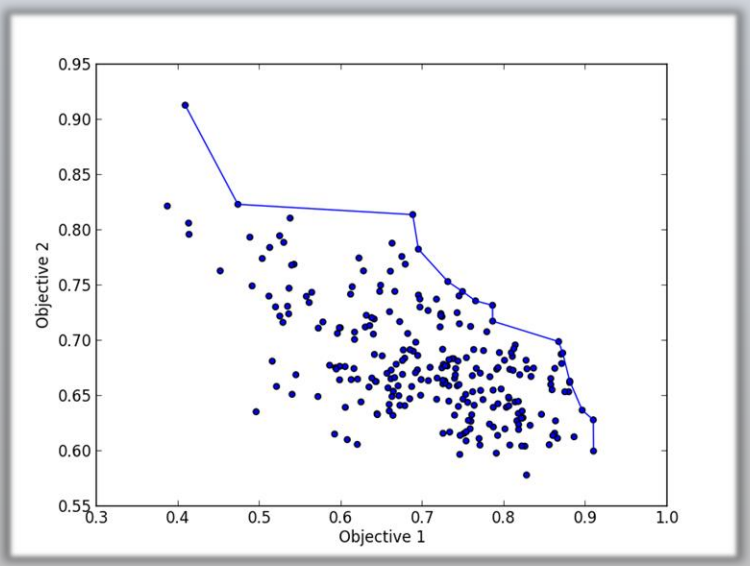
High number of variables for the design process

Non-Linear problem

*PSO Application, Designing and Testing a **HEV***

Search for the **optimal HEV layout**

$$Fitness_{func} = w_{gasol} \cdot cost_{gasol} + w_{prod} \cdot cost_{prod}$$



*PSO Results , Designing and Testing a **HEV***

Still working on it!

Obtained a reduction of **4% ca.** of fuel consumption in **3 PSO iterations**

Problem Definition, ECMS Coefficient Tuning

Velocity – Planner exploiting V2V

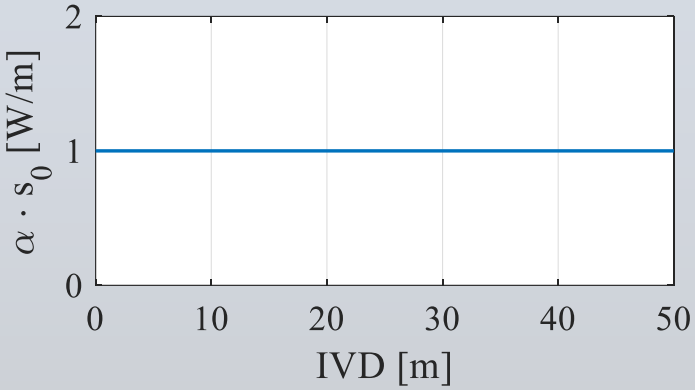
Exploiting the **V2V** information exchanged between two vehicles to decrease the energy consumption of the ego vehicle

Real – Time Control Strategy: ECMS

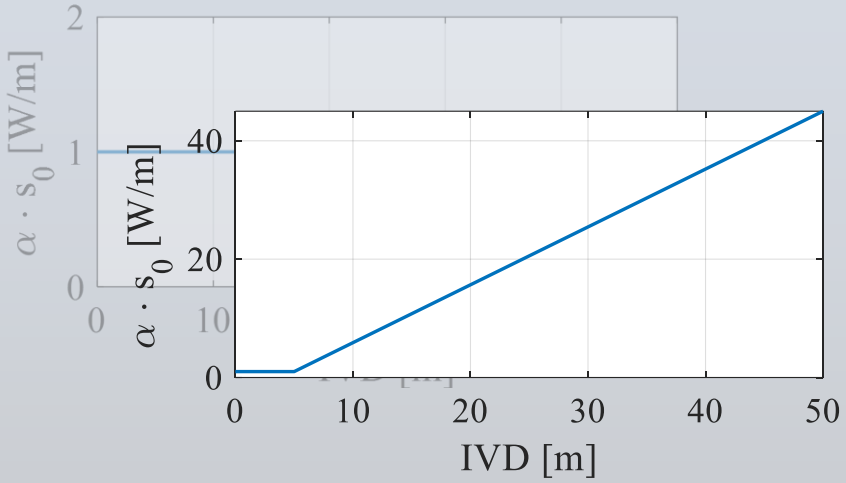
Minimize at each timestep an **Equivalent Consumption** composed of energy consumption and distance between the vehicles

Crucial is the tuning of an **equivalence factor**

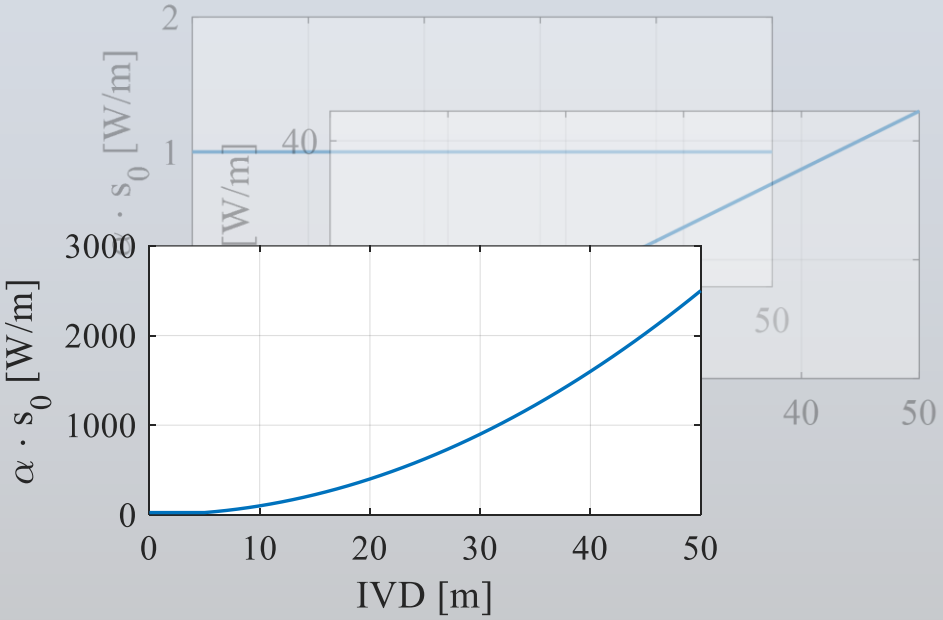
PSO Application, ECMS Coefficient Tuning



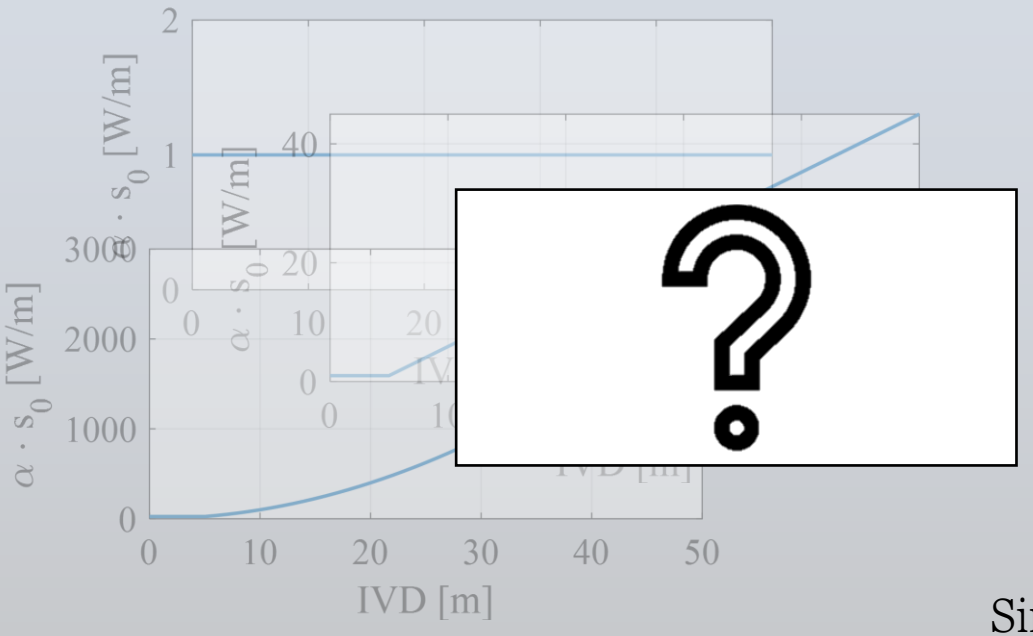
PSO Application, ECMS Coefficient Tuning



PSO Application, ECMS Coefficient Tuning



PSO Application, ECMS Coefficient Tuning



Since the behavior of the equivalence factor is not known **PSO** will be used to determine its value

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Thanks for the attention

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