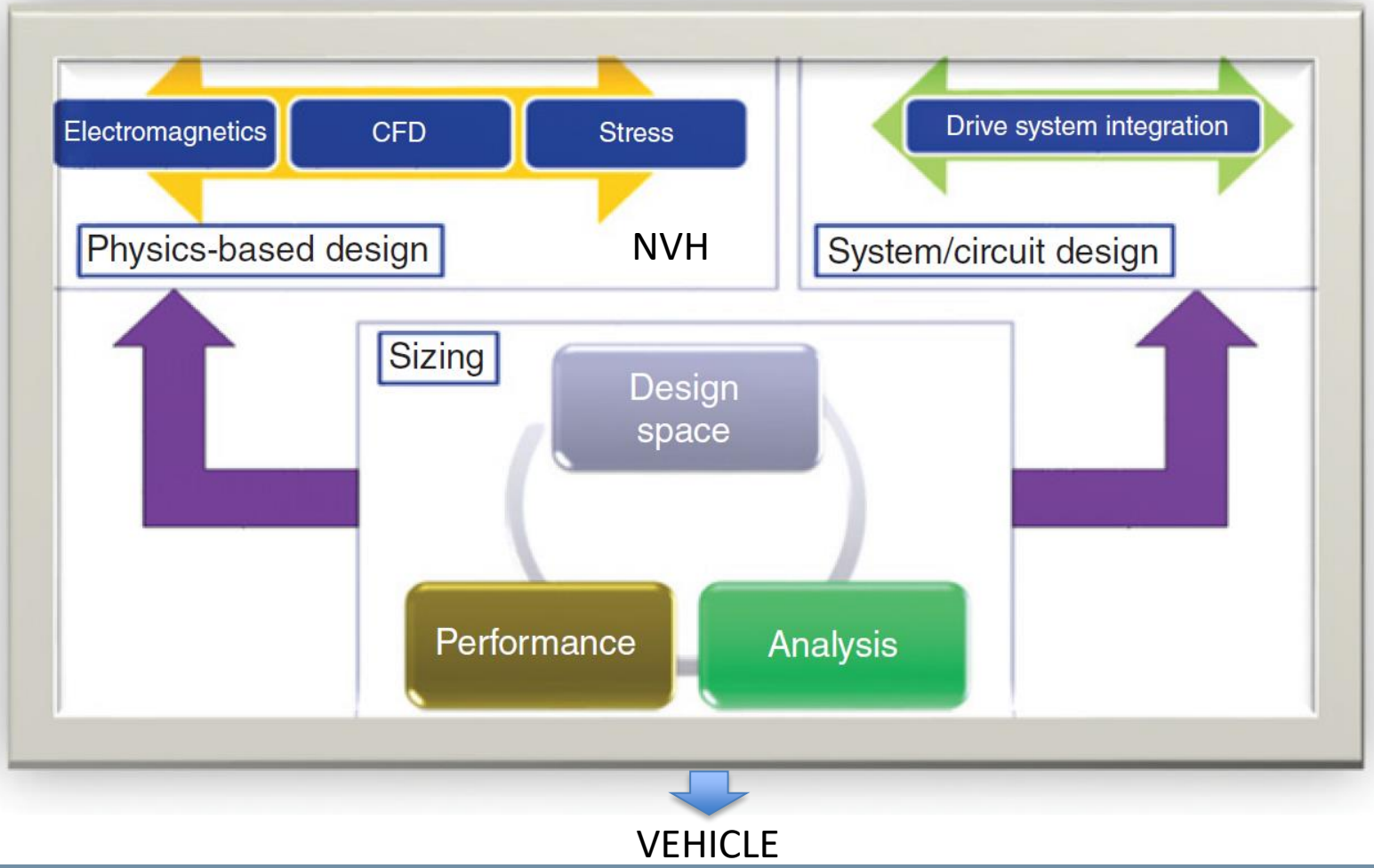
OPTIMAL DESIGN OF AUTOMOTIVE ELECTRIC MOTORS

Rev 1.0 21-04-2022

Multiphysics and multidomain electric machine design flow



Objectives

Number of different physical and engineering aspects

magnetic circuit

magnetic field sources

mechanical architecture (strength, compliance, NVH, …)

thermal aspects

Deriving the optimal solutions in Pareto sense.

Ever-occurring paradigm within automotive field: a single component requires all of the competences needed to design the whole vehicle

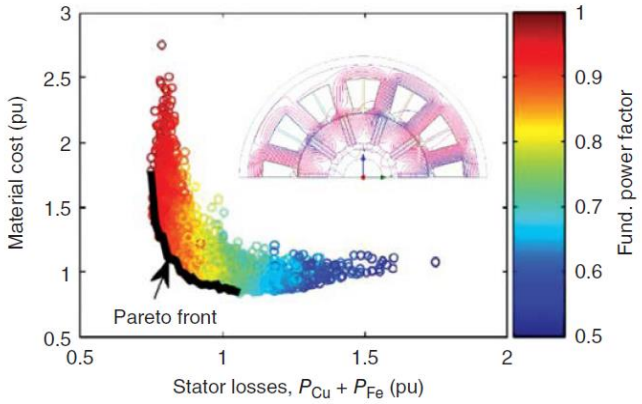
Design Framework

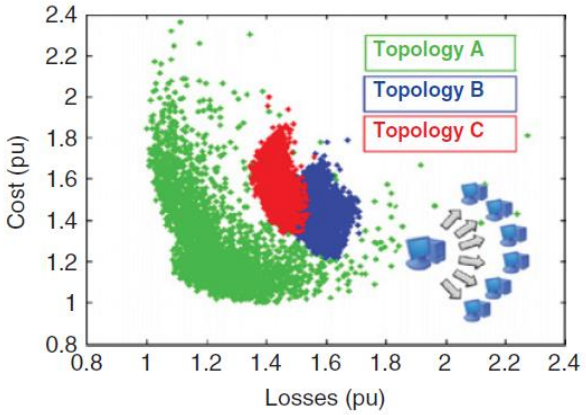
Design of electrical machines is a constrained nonlinear multi-objective problem

Objectives: highest efficiency, lowest cost, minimum mass, …

Electromagnetic problem should be solved with consideration of the mechanical, thermal, and materials constraints.

Pareto front can aid in identifying a family of best designs.

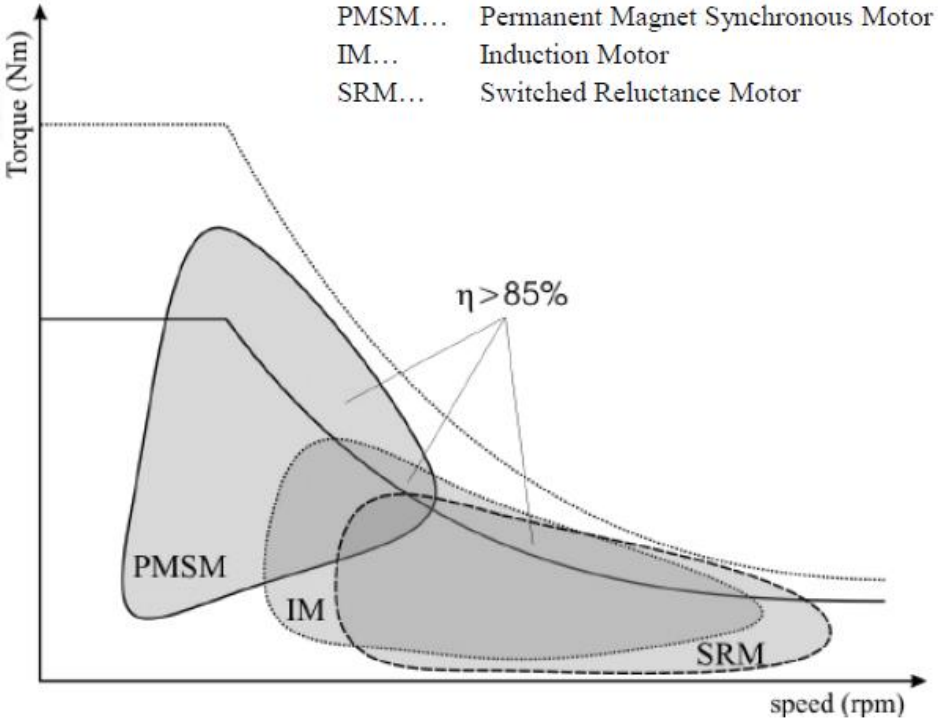


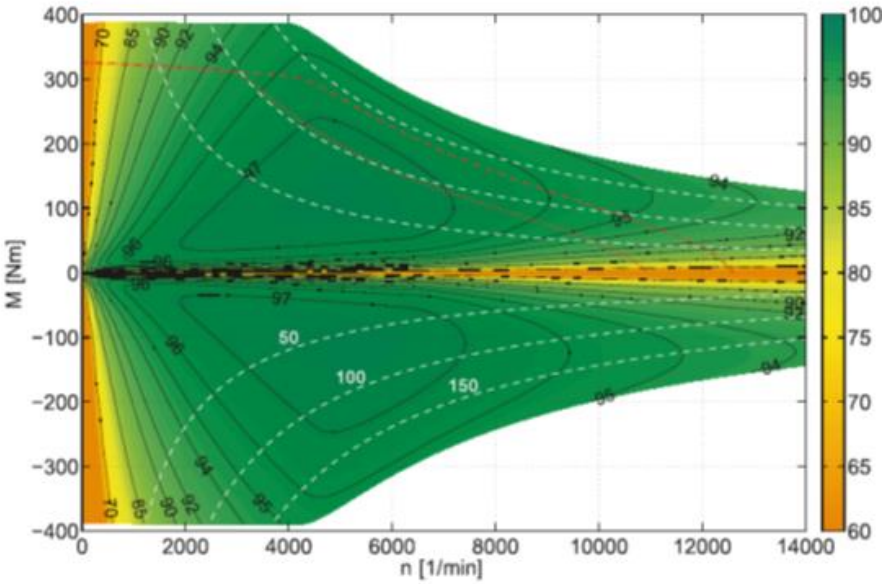


Fair basis for the comparison of different machine topologies.

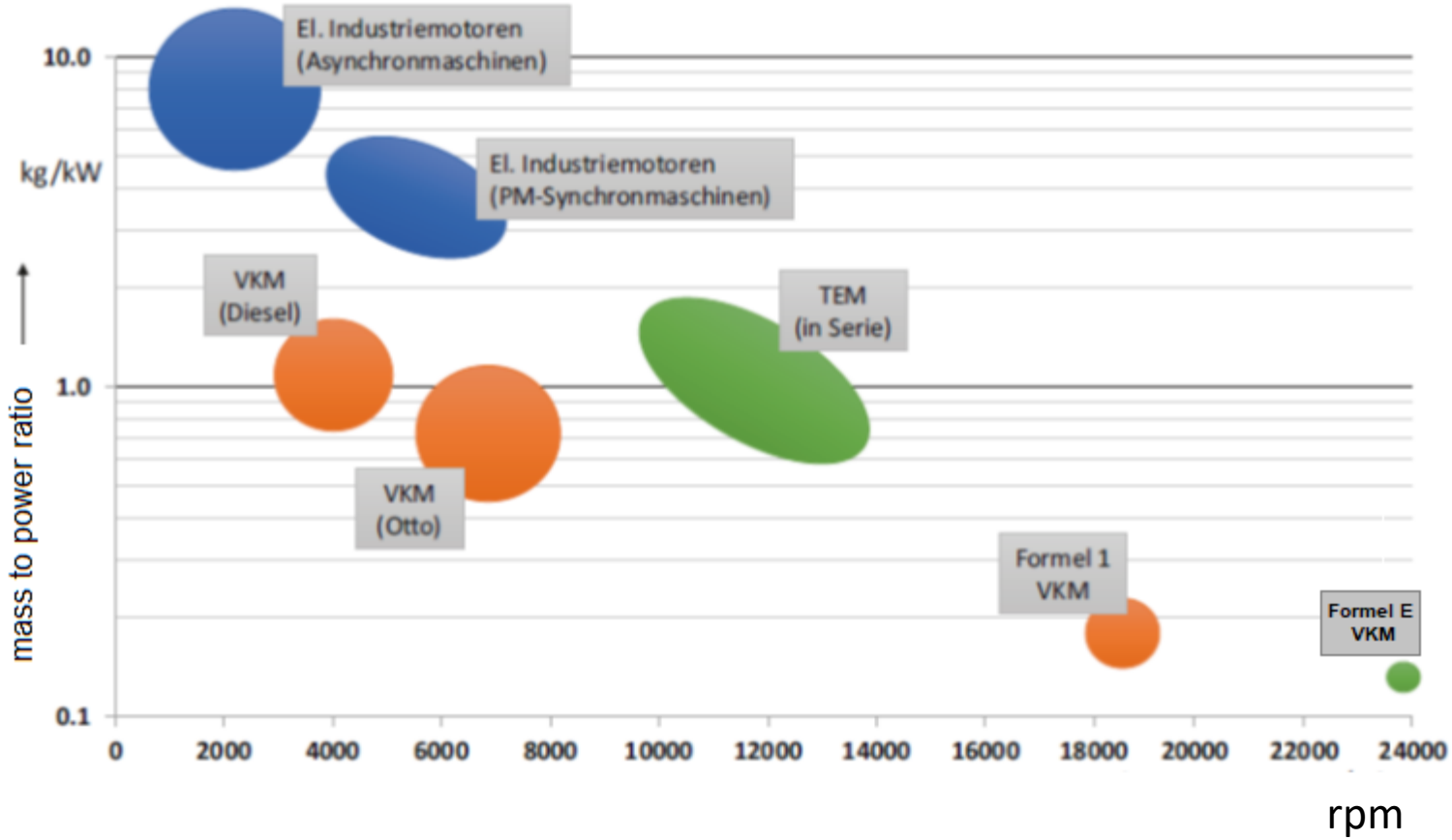
PMSM

PMSM… Permanent Magnet Synchronous Motor
IM… Induction Motor
SRM… Switched Reluctance Motor

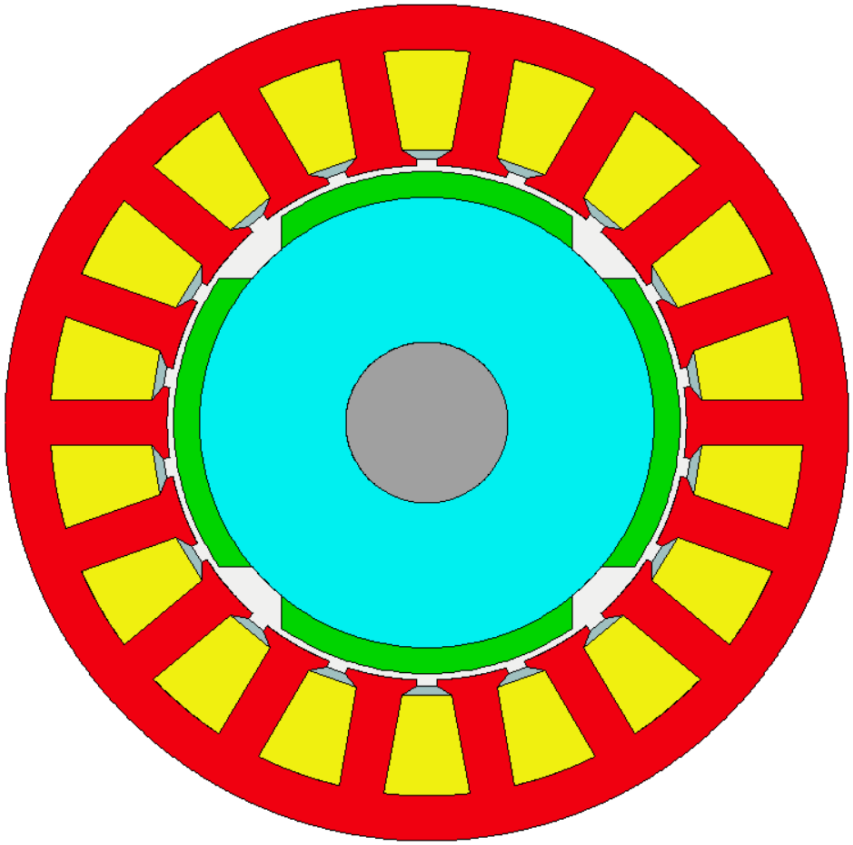


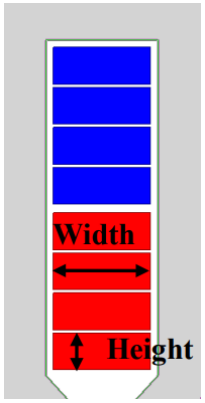


Power-to-mass ratio of different engine technologies



SPM machines





Surface Permanent Magnet (SPM)

10 poles SPM rotor