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An Analysis of Conditions for Efficiency Gains in Large ICEs Using Cycling

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Abstract : This paper investigates the bounds of achievable fuel efficiency improvements in engines due to cycling between two operating points assuming a series hybrid configuration . It is shown that for linear bsfc dependencies (as a function of power), cycling is only beneficial if the average power needs are smaller than the power at the optimal bsfc value. Exact expressions for the fuel efficiency gains relative to the constant output power case are derived. This asymptotic analysis is then extended to the case where transient losses due to a change in the operating point are also considered. The case of the boundary bsfc trajectory where constant power application and cycling yield the same fuel consumption.is investigated. It is shown that the boundary bsfc locations of the second non-optimal operating points is hyperbolic. The analysis of the boundary case allows to evaluate whether for a particular engine, cycling can be beneficial. The introduced concepts are illustrated through a number of real world examples, i.e. large production Diesel engines in series hybrid configurations.

Keywords : cycling, efficiency, bsfc, series hybrid, diesel, operating point
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