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Hybridization and Mission Analysis of a Regional Turboprop

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The potential benefits of hybrid-electric or full-electric propulsion have led to the proliferation of many concepts over the past decade. However, in most cases, concepts are referred to aircraft designed starting from early stages of the design process requiring a specific manufacturing chain. This could lead to aircraft which are less appetible in an industrial or economic sense. The present work proposes a complete application of the design process proposed by the authors in recent publications to refit the propulsive system of an already flying regional turboprop. The hybridization process requires the evaluation of many different powertrain architecture to find the most suited to maximize the fuel saving percentage. The resize of thermal and electric components is based on the power requirements provided by a simulation-based analysis of the mission profile. The reference aircraft is similar to ATR-42.

I. Nomenclature

$(\cdot)_1$	=	subscript for primary propulsive system
$(\cdot)_2$	=	subscript for secondary propulsive system
$C_{(\cdot)}$	=	aerodynamic coefficient
E	=	energy
P	=	power
S	=	wing planform area
W	=	weight
A_s	=	cross-sectional area of the slipstream
A_p	=	area of the disk propeller
T	=	thrust
$V_{(\cdot)}$	=	velocity at the location $(\cdot)$
$a_{(\cdot)}$	=	axial induction at the location $(\cdot)$
φ	=	shaft power ratio
Φ	=	supplied power ratio
η	=	efficiency
χ	=	thrust hybridization factor
OEW	=	Operative Empty Weight
MZFW	=	Maximum Zero Fuel Weight
MTOW	=	Maximum Take-off Weight

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