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Comparison between two target functions for optimization of single phase shaded pole motor using method of genetic algorithms

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Abstract. Method of genetic algorithms is used as optimization technique for improvement of operational characteristics of a single phase shaded pole motor by deriving new improved motor models starting from basic one. First motor model uses electromagnetic torque while second one uses efficiency factor as target function for optimization. Results gained from both models are compared to basic model and conclusions are made regarding the most favorable function for optimization of single phase shaded pole motor.

1. Introduction

Single phase shaded pole motor has wide application in many household devices due to its simple construction, as well as its capability for sustaining overloading in locked rotor position since value of short circuit current is very close to the value of rated current.

In this paper is analyzed single phase shaded pole motor AKO-16, product of MIKRON-Prilep with rated data: $2p=2$; $P_1=24W$; $n_n=2200$ min^{-1} [1]. On Fig.1 is presented motor cross section. Method of genetic algorithms is applied as optimization technique for analyzed motor. It is a powerful numerical tool which enables creating optimal solution of designed electrical machine by optimization of certain machine parameters [2,3]. Two improved motor models are derived. First one uses electromagnetic torque (Model 1) while second one uses efficiency factor (Model 2) as target function which should be improved.

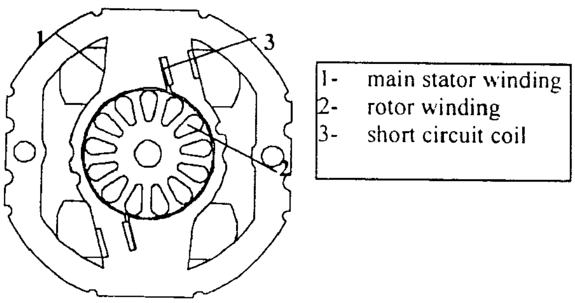


Fig. 1 Motor cross-section

2. Method of genetic algorithm

In both cases following motor parameters are varied:

1. Current density in stator winding Δ [5÷10] [A/mm^2].
2. Specific magnetic induction B [0.4÷0.45] [T].
3. Angle of rotor skew α_{sk} [15÷20] [°].

Program of genetic algorithms creates 6000 generations of each varied parameter. As output program gives the most favorable set of varied parameters with which the largest electromagnetic torque or efficiency factor can be obtained. In Table 1 is given overview of output sets of varied parameters in both motor models.

Table 1. Set of varied motor parameters

Basic model	Model 1	Model 2
Δ=8 [A/mm^2]	Δ=5,346 [A/mm^2]	Δ=5,199 [A/mm^2]
B=0,404 T	B=0,44995 T	B=0,443335 T
α_{sk}=17°	α_{sk}=15,0005	α_{sk}=15,0025

As a result of prescribed variations in Table 1 motor parameters are changed and consequently motor operation characteristics, as well.

3. Comparison between two motor models

In Table 2 is presented comparison between motor characteristics of basic model and two new derived models at rated load condition, meaning slip s=0,16

Table 2. Comparison of motor characteristics

Motor data	Basic model	Model 1	Model 2
Stator current I_1 [A]	0,1259	0,1679	0,1632
Short circuit coil current I_3 [A]	0,0063	0,0083	0,008
Rotor current I_2 [A]	0,0878	0,1175	0,1142
Power factor cosφ [/]	0,6539	0,5858	0,5843
Input power P_1 [W]	18,114	21,634	20,979
Output power P_2 [W]	1,7647	2,773	2,6919
Efficiency factor η [/]	0,0974	0,128183	0,128313
Electromagnetic torque M_{em} [Nm]	0,009037	0,012859	0,012551

In table 3 is presented percentage improvement of M_{em} and η, in Model 1 when M_{em} is a target function for optimization as well as in Model 2 when η is a target function , compared to the basic motor model.

Table 3. Percentage improvement of M_{em} and η compared to basic model

Basic model		Model 1		Model 2	
M_{em}	η	M_{em}	η	M_{em}	η
0,009037	0,097423	0,012859	0,128183	0,012551	0,128313
Improvement compared to basic motor model [%]		29,72	23,9915	27,99	24,073

On Fig.2 is presented M_{em}=f (s) while on Fig.3 is presented η=f (P_2) for basic model as well as for two new derived models.

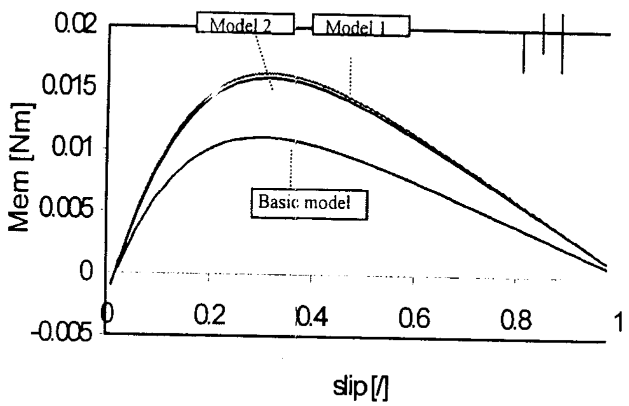
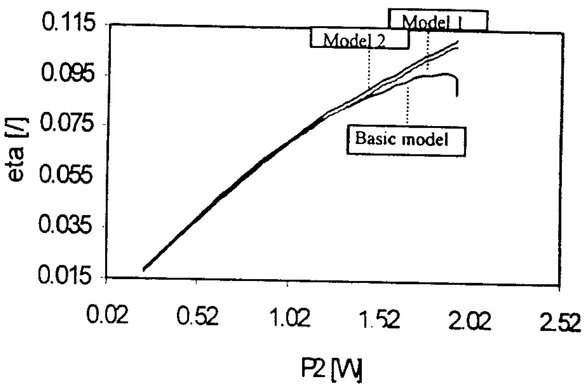


Fig.2 M_{em}=f (s) for basic and improved motor models



Eig.3 η=f (P_2) for basic and improved motor models

In full paper version more relevant motor parameters will be presented as well as deepened analyses of motor operational characteristics.

4. Conclusion

From the Table 3 following conclusion can be made: Model 1 shows better characteristics compared to Model 2. Model 1 achieves larger torque increasment (which is comprehensive considering that Model 1 is developed for M_{em} as target optimization function). But in the same time Model 1 has only slightly smaller efficiency factor than Model 2 (which was developed for η as target optimization function). So proper choice of target optimization function for this type of motor is accepted to be electromagnetic torque.

References

[1] V.Sarac, L.Petkovska, M.Cundev ,"An improved performance analyses of a shaded pole motor," PCIM 2001, Nuenberg, 19-21 Juni 2001, Germany.

[2] V.Sarac, M.P.Radevska, L.Petkovska, M.Cundev, "An improved model of single phase shaded pole motor by method of genetic algorithms," ELMA 2002, Sofia, p.p 23-30, September 2002, Bulgaria

[3] G.V.Cvetkovski, L.Petkovska, M.Cundev, S.Gair, "Genetic algorithm approach in design optimization of a permanent magnet axial field motor," ISEF'99, Pavia, p.p 385-388, Italy