## A New Dynamic Parameterization Of the Jiles-Atherton Model

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The original Jiles Atherton model for hysteretic materials has been used in literature and industry applications for many years. The model is identified by a set of five parameters, accounting for the physical properties of the material, which must be defined. In particular, the reviewed model proposed by Jiles takes into account the movement of domain walls in presence of pinning sites. The parameter k of the model express the energy loss due to this phenomenon. A frequent approach used in literature is to express the parameter k not as a constant, but as a function of the magnetic field [1-2]. This yields better performance of the model over distorted excitations, i.e. ones were the hysteresis loops are smaller than the saturated one (see Fig. 1). The model proposed in the present paper expands this concept, expressing all the five parameters of the classic model as a linear combination of a constant and an excitation-dependant factor, thus creating a ten parameter model. The purpose of this work is to determine whether this modified model can outperform the classic one when distorted hysteresis cycles are involved. The followed approach is to identify the parameters, in both models, for a wide set of reference materials. Then, for each material, the found solutions (parameters sets) are validated on a set of new, randomly distorted excitations, creating a comparative statistic on whichever model is preferable to represent the material. The non-linear optimization technique called Continuous Flock-of-Starlings Optimization Cube (CFSO3) [3] were used for the identification of the parameters.

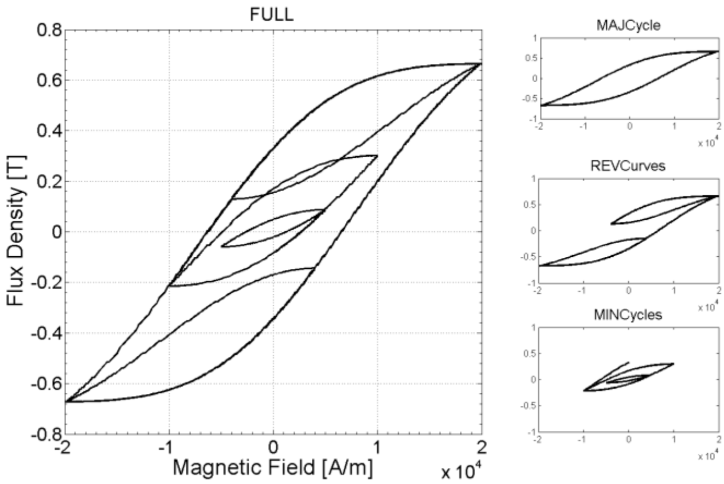


**Figure 1.** Minor loops and first order reversal curves obtained by the proposed model.

[1] P.R. Wilson, J.N. Ross and A.D. Brown, Optimizing the Jiles-Atherton model of hysteresis by a genetic algorithm, IEEE Transactions on Magnetics, 2001, pp 989-993

[2] M. Toman, G. Stumberger and D. Dolinar, Parameter identification of the Jiles–Atherton hysteresis model using differential evolution. IEEE Transactions on Magnetics, 2008, pp 1098-1101

[3] A. Laudani, F. Riganti Fulginei, A. Salvini, M. Schmid and S. Conforto, CFSO3: A New Supervised Swarm-Based Optimization Algorithm, Mathematical Problems in Engineering, 2013