Investigating laser patterns for GOES submitted to misoriented flux with a 2D vector model.

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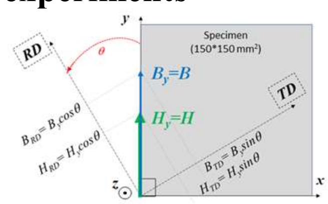
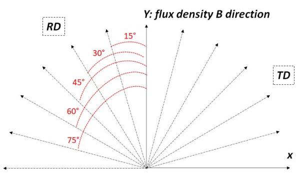
Introduction: Inductors and transformers with rectangular, U or E shaped magnetic cores have got corners or columns where the flux makes an angle with the Rolling Direction (RD). Any misoriented flux in a GOES significantly increases the losses by a factor from 2 to 5. This work contributes to the research on the ability of laser treatments to be locally compatible with misoriented flux inside electrical steels.

Samples & experiments

Standard conventional GOES SiFe grade R120-27
thickness = 0,27 mm

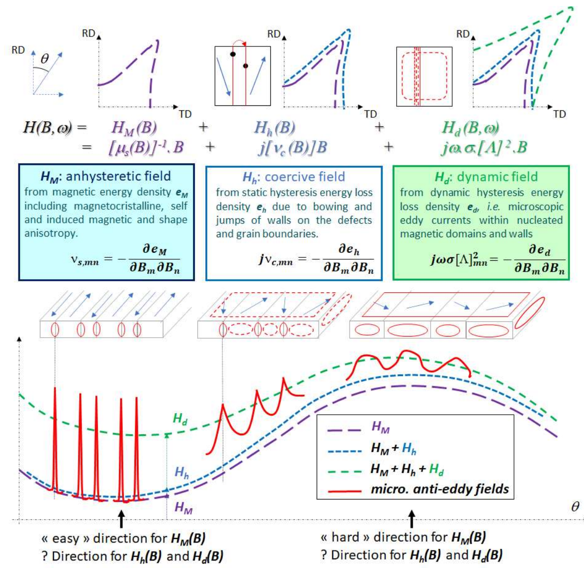




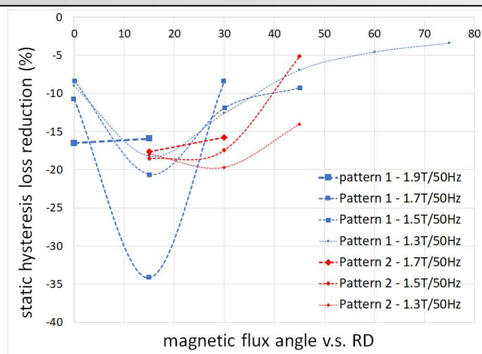
Samples cut with various angle v.s. RD
Lis of samples defined below
various laser patterns investigated for each

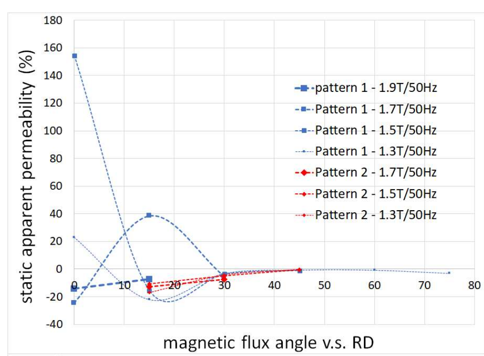
sample	ANGLE(Y, RD) / ANGLE(B, RD)	Direction of flux B measured and components in (TD,RD) frame
0	θ=0°/0°	y (B_{RD}=B_y, B_{TD}=B_x=0)
0	θ=0°/90°	x (B_{RD}=B_x=0, B_{TD}=B_y)
15	θ=15°/15°	y (B_{RD}=$B_y$cos15, B_{TD}= $B_y$sin15)
15	θ=15°/75°	x (B_{RD}=$B_x$cos75, B_{TD}= $B_x$sin75)
30	θ=30°/30°	y (B_{RD}=$B_y$cos30, B_{TD}= $B_y$sin30)
30	θ=30°/60°	x (B_{RD}=$B_x$cos60, B_{TD}= $B_x$sin60)
45	θ=45°/45°	y (B_{RD}=$B_y$cos45, B_{TD}= $B_y$sin45)
45	θ=45°/45°	x (B_{RD}=$B_x$cos45, B_{TD}= $B_x$sin45)
60	θ=60°/60°	y (B_{RD}=$B_y$cos60, B_{TD}= $B_y$sin60)
60	θ=60°/30°	x (B_{RD}=$B_x$cos30, B_{TD}= $B_x$sin30)
75	θ=75°/75°	y (B_{RD}=$B_y$cos75, B_{TD}= $B_y$sin75)
75	θ=75°/15°	x (B_{RD}=$B_x$cos15, B_{TD}= $B_x$sin15)
90	θ=90°/90°	y (B_{RD}=$B_y$cos90=0, B_{TD}=$B_y$sin90=B_y)
90	θ=90°/0°	x (B_{RD}=$B_x$cos0=B_x, B_{TD}=$B_x$sin0=0)

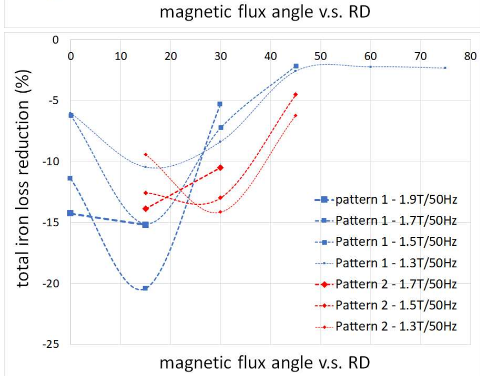
2D vector magnetic model

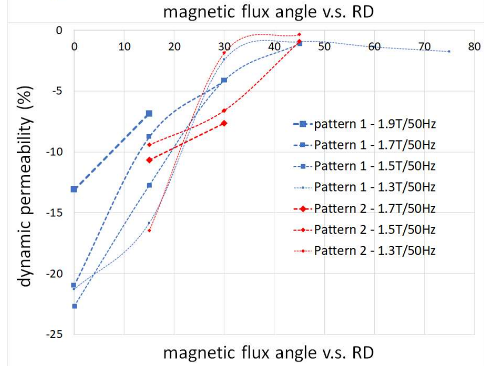


Results for a fundamental @ 50Hz v.s. angle between Flux direction and Rolling Direction (RD)









Conclusion: This ambition to control the loss reduction factors within misoriented flux requires to provide a vectorial description of the magnetic behaviour in 2D, able to predict the losses in any direction, and sensitive to the effect of a laser treatment in relationship with the magnetic domain structure.

Laser treatment are performed by MULTITEL. Magnetic modeling and measurements are carried out by the UNILASALLE Amiens.
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