The Concertina Pattern
Experiments, Analysis, Numerical Simulations

The concertina pattern occurs as a meta-stable stage during the switching process of elongated ferromagnetic thin-film elements under an external magnetic field. It consists of a nearly periodic array of folds in which the magnetization is almost constant. These folds are separated by sharp transition layers. As the strength of the (opposed) external field increases, some folds collapse thus increasing the average period of the pattern.

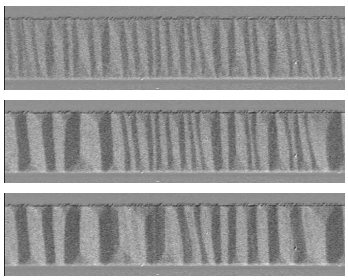

Figure 1: Experiments by R. Schäfer, IfW Dresden.

A linear stability analysis based on the micromagnetic energy functional shows that a periodic instability actually appears as the first unstable mode in the relevant parameter regime. In this regime, a reduced energy functional was rigorously derived by R. Cantero and F. Otto. Based on asymptotic analysis and numerical simulations of this reduced energy functional, we can answer the following natural questions:

- What is the relation between the period of the unstable mode and the initially observed period of the pattern?
- What is the origin of the scale separation in the domain-wall pattern?
- Why does the optimal period increase and what is the type of the nonlinear secondary instabilities (e.g. Eckhaus)?

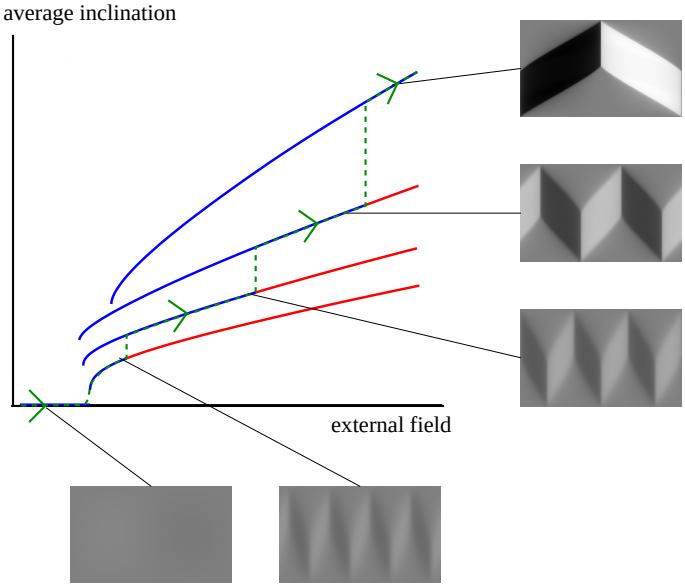

Figure 2: Numerical simulation.