CAPRES A/S
COPENHAGEN APPLIED RESEARCH

The fitting algorithm for the CIPT Model

Introduction

The approach is to make a function which has the parameters and the measured data as argument. This function should have a minimum in the parameter point where the measured data have the highest agreement with the parameters of the model.

To optimize the parameters and find the minimum the CIPTech fitting algorithm make repeated use of the Downhill Simplex Method. A detailed description of the algorithm can be found in Numerical Recipies[1].

The model

Dr. Daniel Worledge is the inventor of the CIPT model used in the CIPTech. The model itself is described in the paper: "*Magnetoresistance measurement of unpatterned magnetic tunnel junction wafers by Current In-Plane Tunneling*", D. Worledge and P. L. Trouilloud, Applied Physics Letters Vol 83 1 pp 84-86 July 7th 2003.

The name conventions used for the parameters in the paper, the CIPTech and the source code can be confusing. R_t is identical to R_f, and R_b is also known as R_p.

The input

The input consists of three arrays where each row is a four point probe configuration.

- An array with three columns containing the spacing between the cantilevers.
- An array of measured R simply U/I without any correction factors for probe geometry.
- An array with the measured MR_{cip}.

The algorithm

In the following expression `fitmrerrgeneral` and `fitmrerrgeneralnorf` are the functions which are minimized by the Downhill Simplex method. The return value from these functions is the minimum value in the parameter point – lower value corresponds to better agreement with the model.

The main algorithm proceeds in the following steps:

1. Optimize all parameters R_t, R_b, RA, MR to minimize f = `fitmrerrgeneral`.
2. Do linear search by changing R_t in step of 0.2 in the direction there minimize f when the parameters R_b, RA, MR are optimized to minimize f = `fitmrerrgeneralnorf` for fixed R_t.
3. Bisection method around R_t with steps of $0.1 \cdot 2^{(1-i)}$ where i = 1, 2, ... , 5, to optimize parameters R_b, RA, MR to minimize f = `fitmerrgeneralnorf`
4. Return the value of R_t, R_b, RA, MR and f

[1] http://www.library.cornell.edu/nr/bookcpdf/c10-4.pdf