Magnet model

Magnet positioning model in Reves DSE

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Acknowledgements

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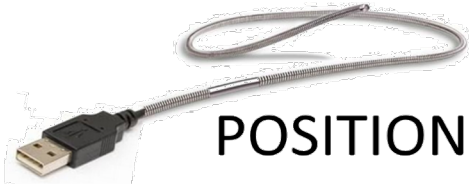

ECSEL Joint Undertaking

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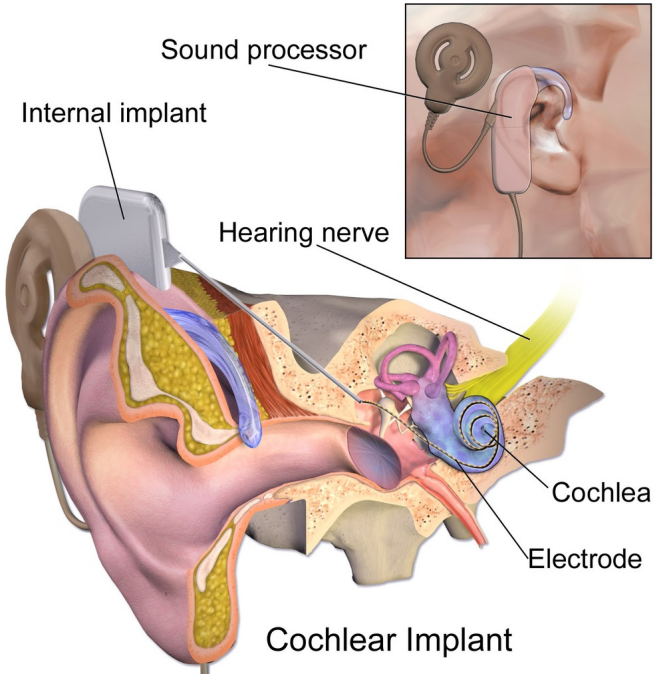
Introduction

Magnets can be used for alignment and fixation of two parts without direct contact.

A nice example is a Cochlear implant where the transmitter is placed on top of the skin while the receiver is implanted underneath the skin. Fixation force and alignment are two important factors in the performance of the total device.

In this presentation we will present a model to predict the performance and a software solution to optimize the design.



Model description

Steps

Step 1: Create surrogate model

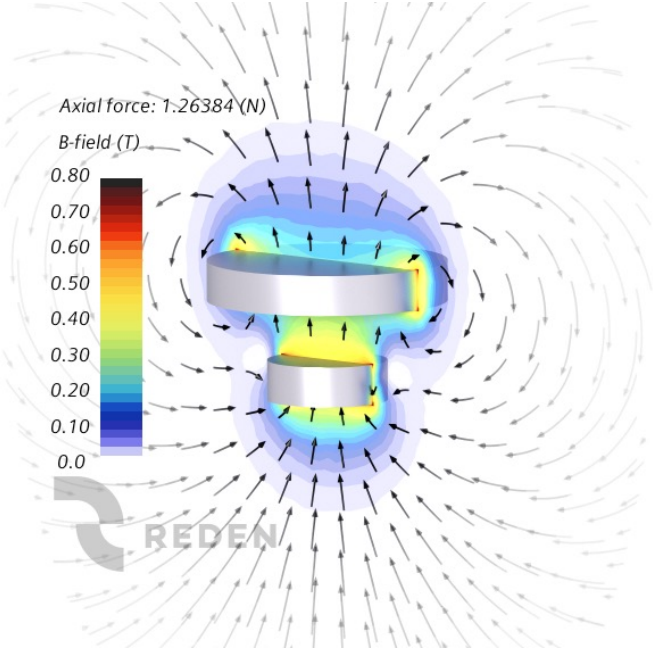
A surrogate model is created that predicts the forces between two magnets

Step 2: Stability check

Will the magnet stay attached, or will it snap into another position?

Step 3: Predict end position

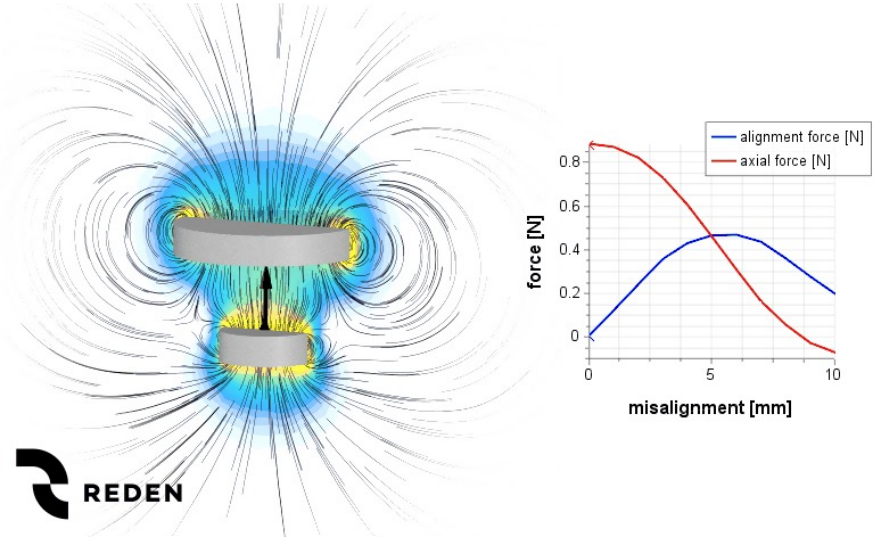
If not stable, what is the end position?



Model description

Step1: Create surrogate model

The forces between the magnets have been calculated with a numerical model for different gap heights and misalignment. The model is validated experimentally.

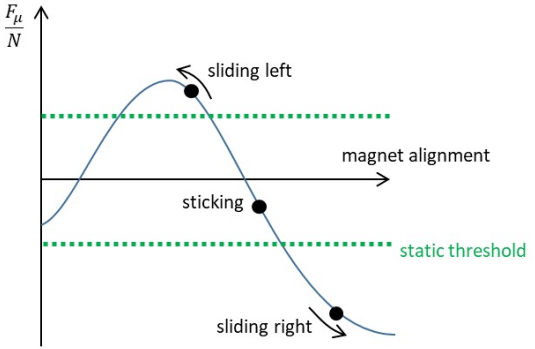


Model description

Step 2: Stability check

Stability is checked by verifying that the needed frictional force is smaller than the normal force times the COF.

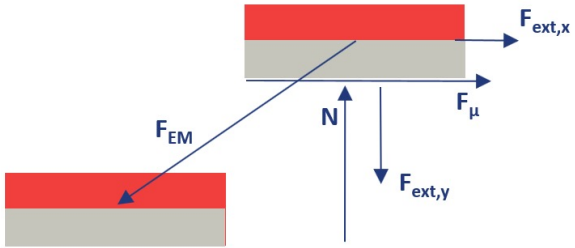
Possible external forces like gravity or acceleration are taken into account.

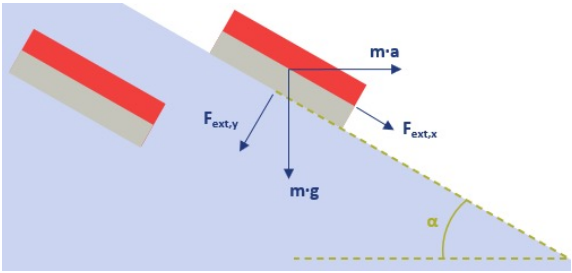


Sticking: $\left|\frac{F_\mu}{N}\right| < \mu_s$

Sliding left: $\frac{F_\mu}{N} > \mu_s$

Sliding right: $\frac{F_\mu}{N} < \mu_s$



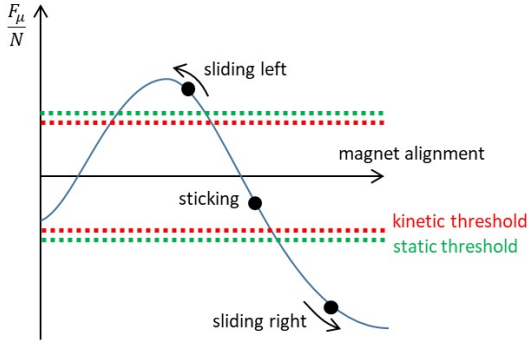


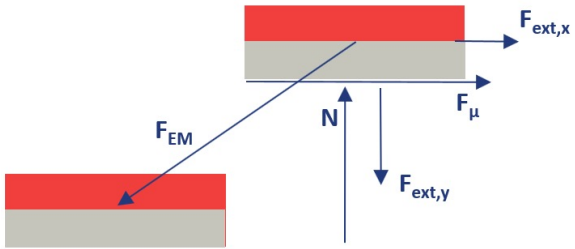
Model description

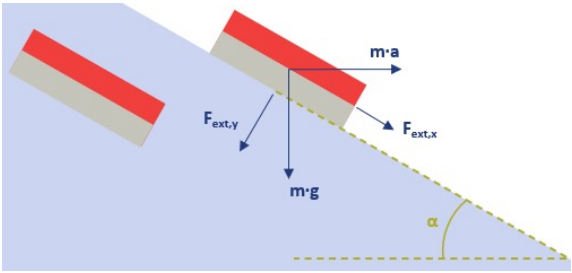
Step 3: end position

Knowing the sliding direction, a stable end position is found when:

$$\left|\frac{F_\mu}{N}\right| = \mu_k$$







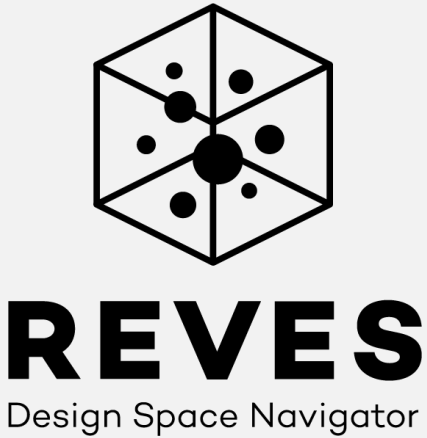
Reves DSE

Design Space Exploration

“Accuracy and accessibility are defining the quality of knowledge”

With Reves DSE software;

- Knowledge is stored in a readable format (document form)
- Knowledge is directly useable for design space exploration

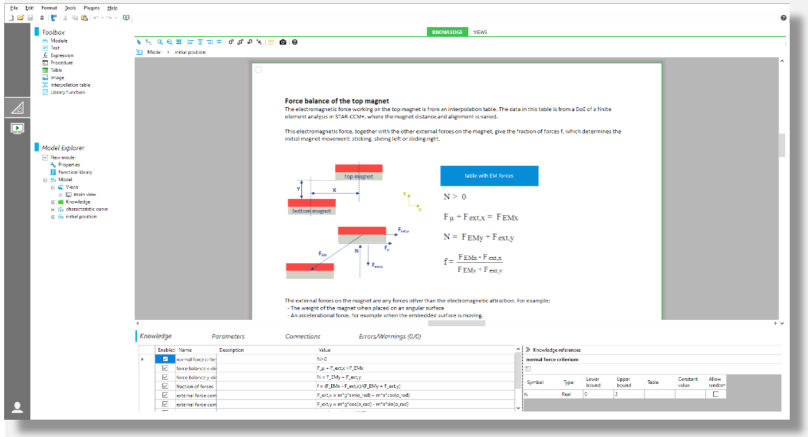


Reves DSE

Design Space Exploration

Knowledge as described in the former sheets is used to create a readable knowledge model. Resulting in:

- Maintainable knowledge
- Lower risk on errors



Readable knowledge model

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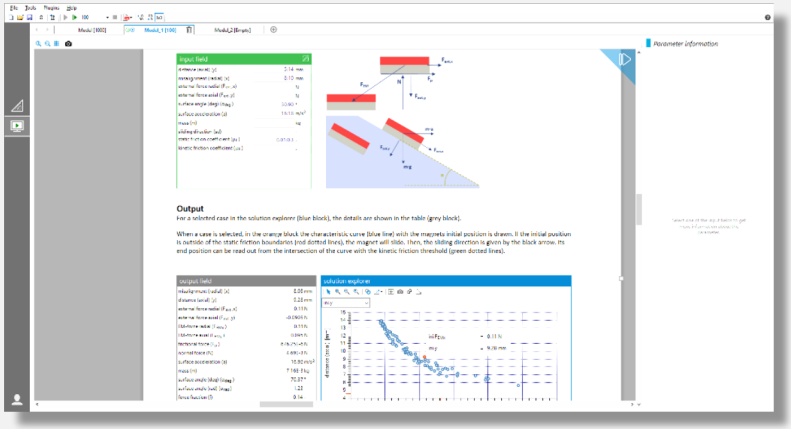
Design Space Exploration

“The design tool will help to navigate the design space and find the desired solution.”

Navigating the design space, finding the solutions based on the knowledge model is made easy in the views.

The Monte Carlo approach balances control and flexibility.



View to navigate the design space

Example use case

Magnet coupling for the External Pulse Generator (EPG) of an implant

A free full functional trial version of Reves DSE can be downloaded by following this link:

Reves DSE installation

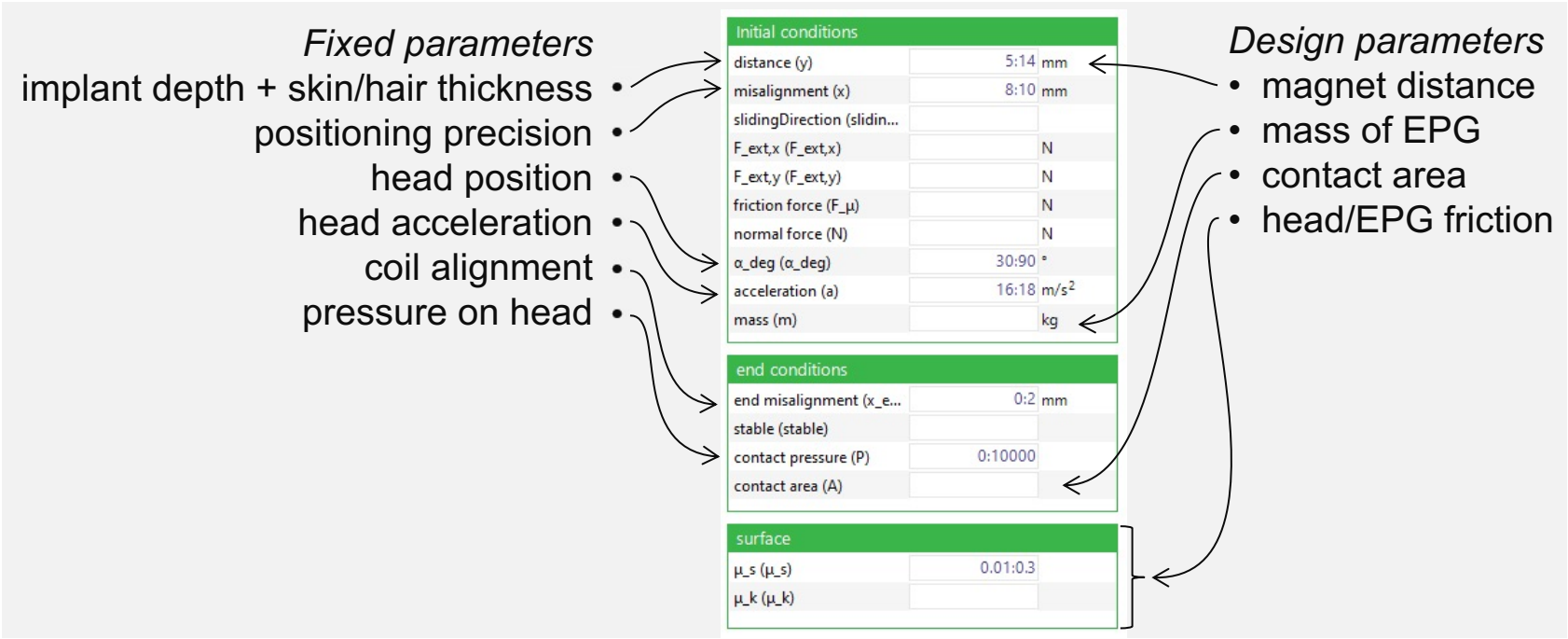
Next, the link below can be used to download the Magnet positioning model:

Magnet Positioning model

Reves DSE helpdesk: https://helpdesk.reden.nl/UserManual/index/

Example use case

Example settings for design space exploration

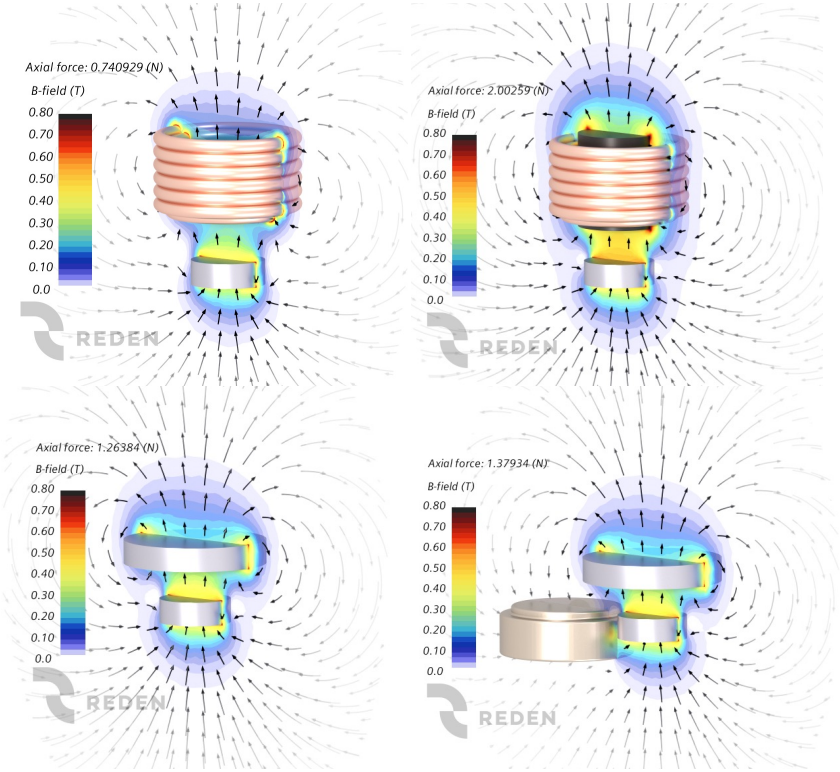


Other examples for applications

The current model is specific for the two chosen magnets: their dimensions and material properties. However, the model can be easily changed to fit any application.

Example applications:

- Excitation coils for flexible magnetic force regulation
- Directing the magnetic field with a focus cup and/or ferrite cores
- Smart battery and/or induction coil positioning to increase retention force



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Thanks for your attention!

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