High Speed Inductive eRPS Sensor Error Reduction Using COMSOL Multiphysics®

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Outline

I. Background – Motivations – Objectives

II. Modelling and Numerical Model

III. Main Results

IV. Conclusions – Perspectives

Before starting, who we are… www.simtecsolution.fr

SIMTEC : Fundamentals

- French Numerical modelling consultancy
- Leader in France of the COMSOL Certified Consultants, key partner worldwide
- 7 members Eng.D. + Ph.D.
- Main partners:
  - big international companies
  - laboratories
- Involved in the Research projects like EU FP (SHARK, SisAl)/ PhD supervision

INNOVATION RADAR
European Commission
SHARK INDUSTRIALISING LASER FUNCTIONAL TEXTURING
SisAl Pilot

I. Background – Motivations – Objectives

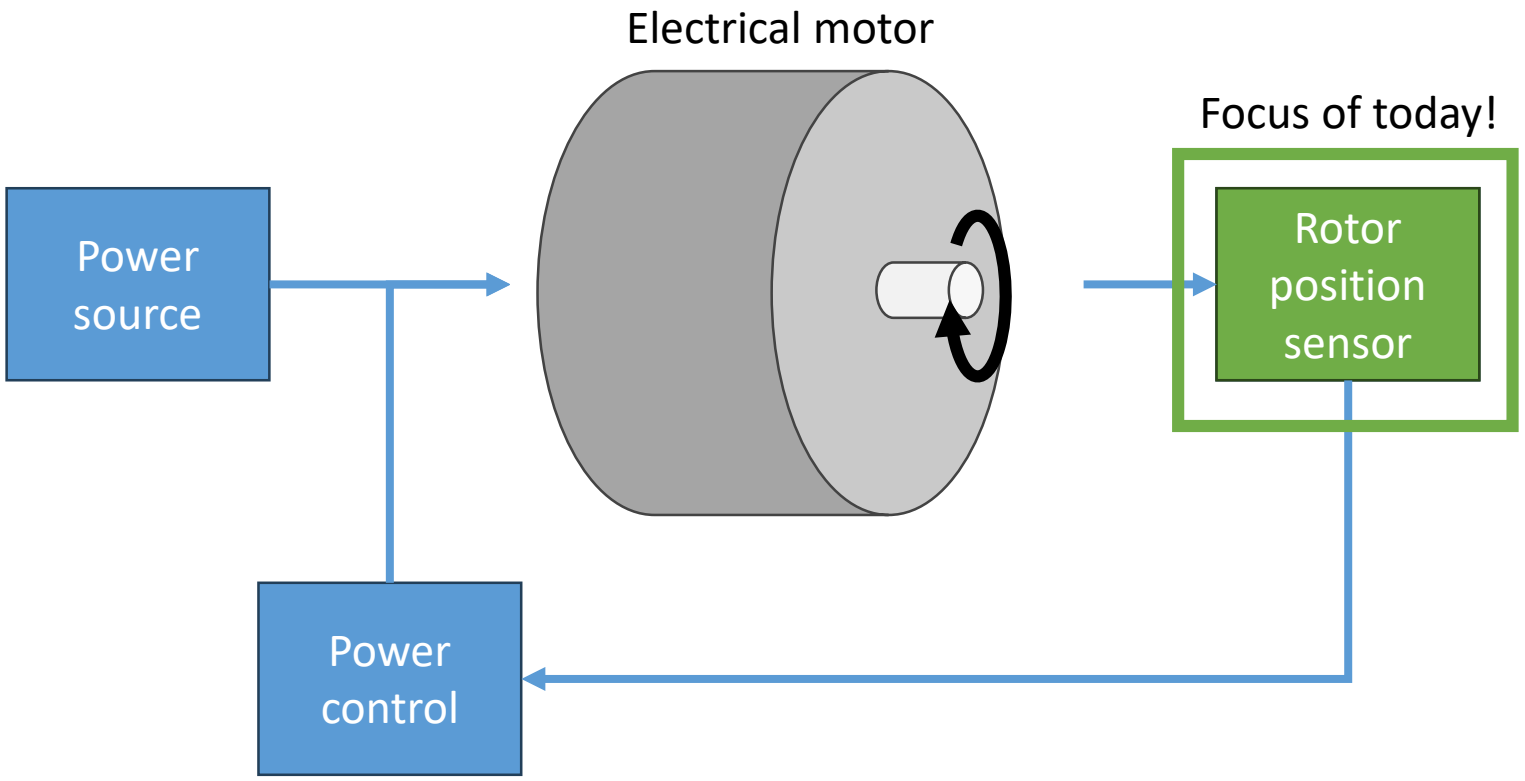


Diagram of an electrical motor and its control loop

I. Background – Motivations – Objectives

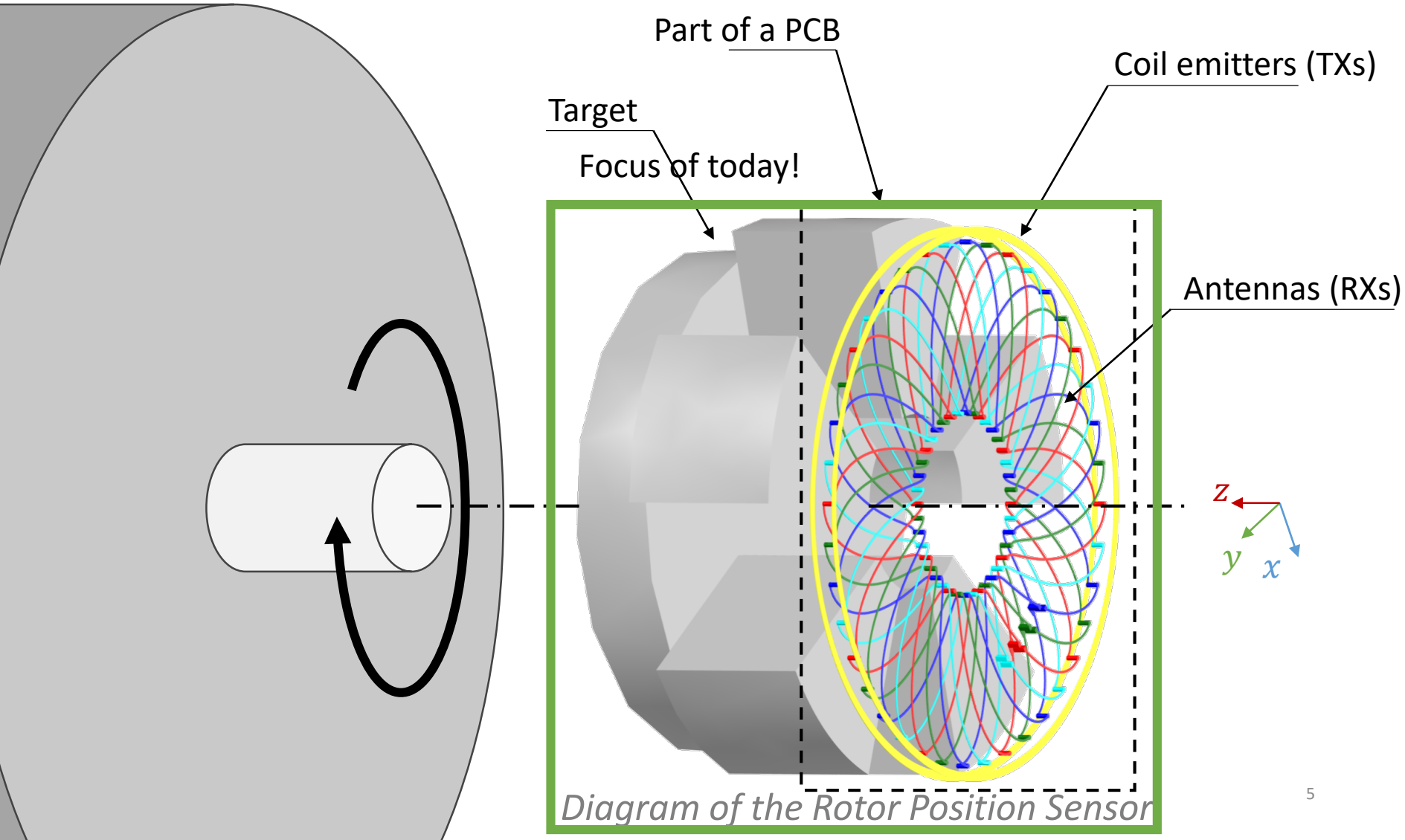
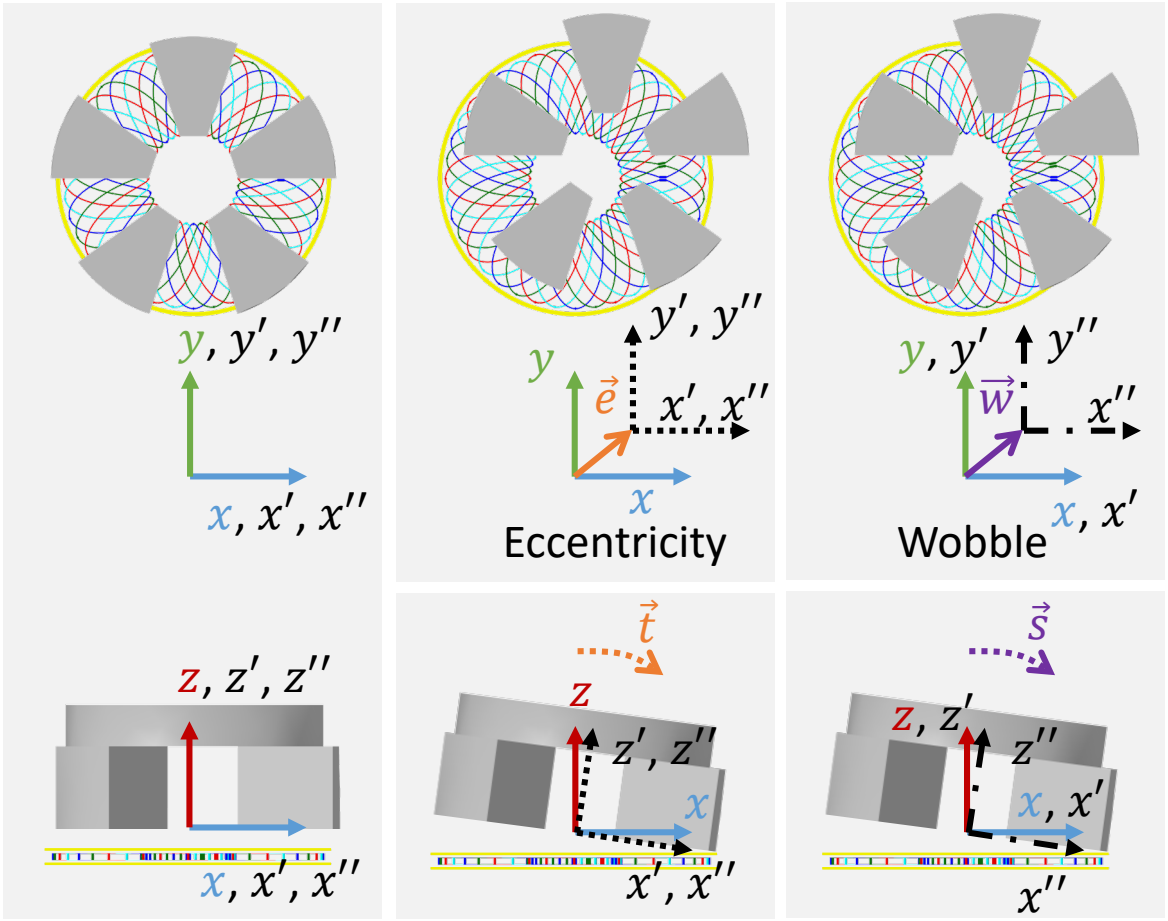


Diagram of the Rotor Position Sensor

I. Background – Motivations – Objectives



PCB and target alignment configurations

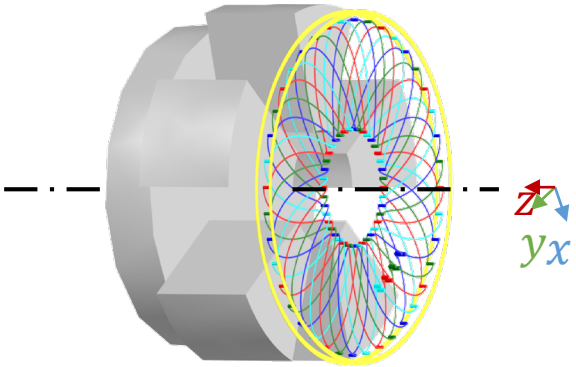
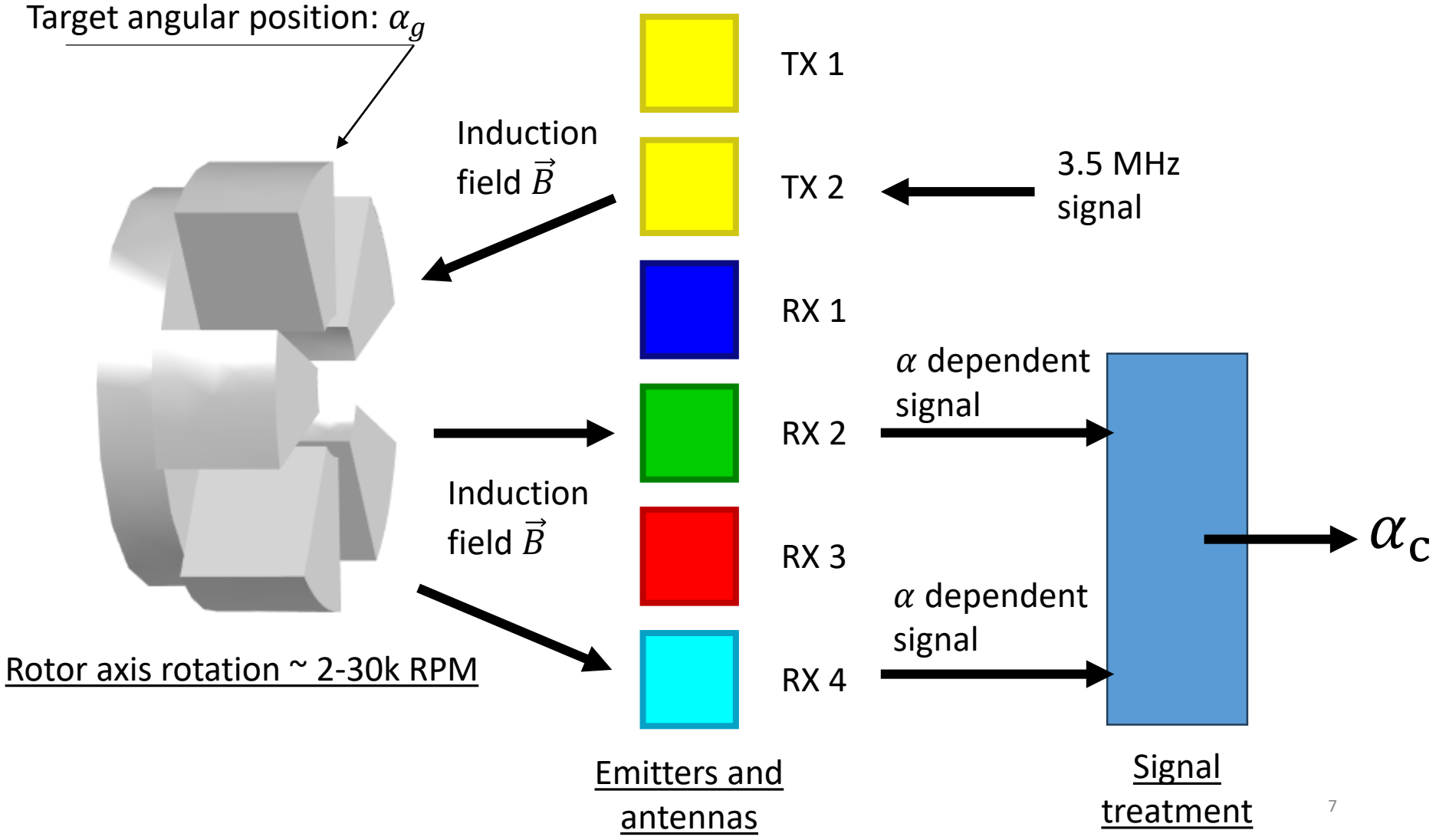


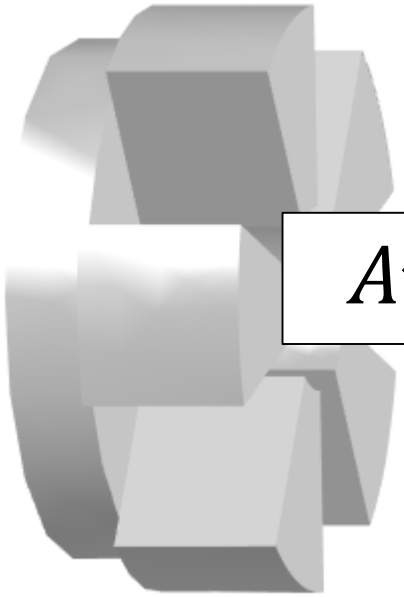
Diagram of the Rotor Position Sensor

II. Modelling and Numerical Model

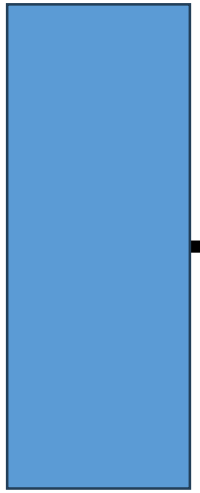


II. Modelling and Numerical Model

Target angular position: α_g



$$Angle\ error = \alpha_g - \alpha_c$$



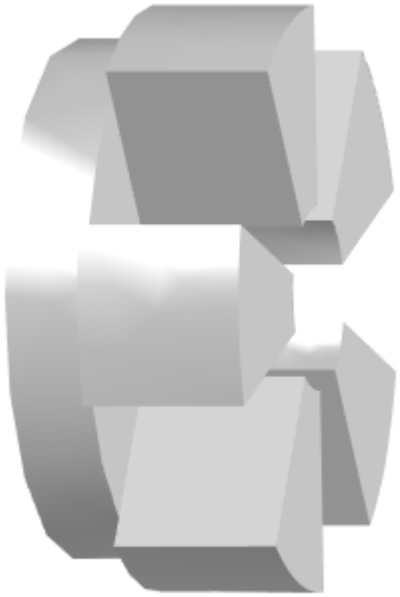
α_c

Signal treatment

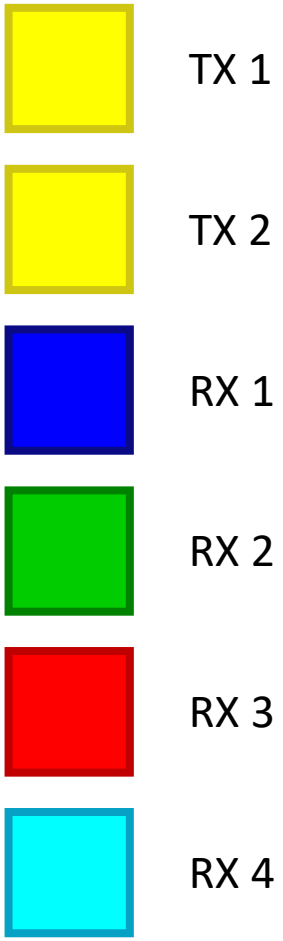
Rotor axis rotation ~ 2-30k RPM

II. Modelling and Numerical Model

Rotating domain



Rotor axis rotation ~ 2-30k RPM



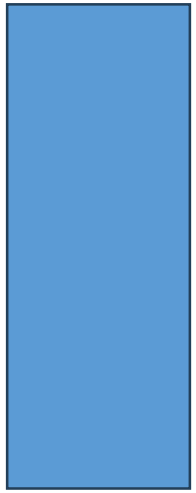
Emitters and antennas

Maxwell equations

Mixed formulation:

- Maxwell Ampère (Mag. Vec. Pot.)
- Maxwell Flux (Mag. Scalar. Pot.)

Excel post-treatment



Signal treatment

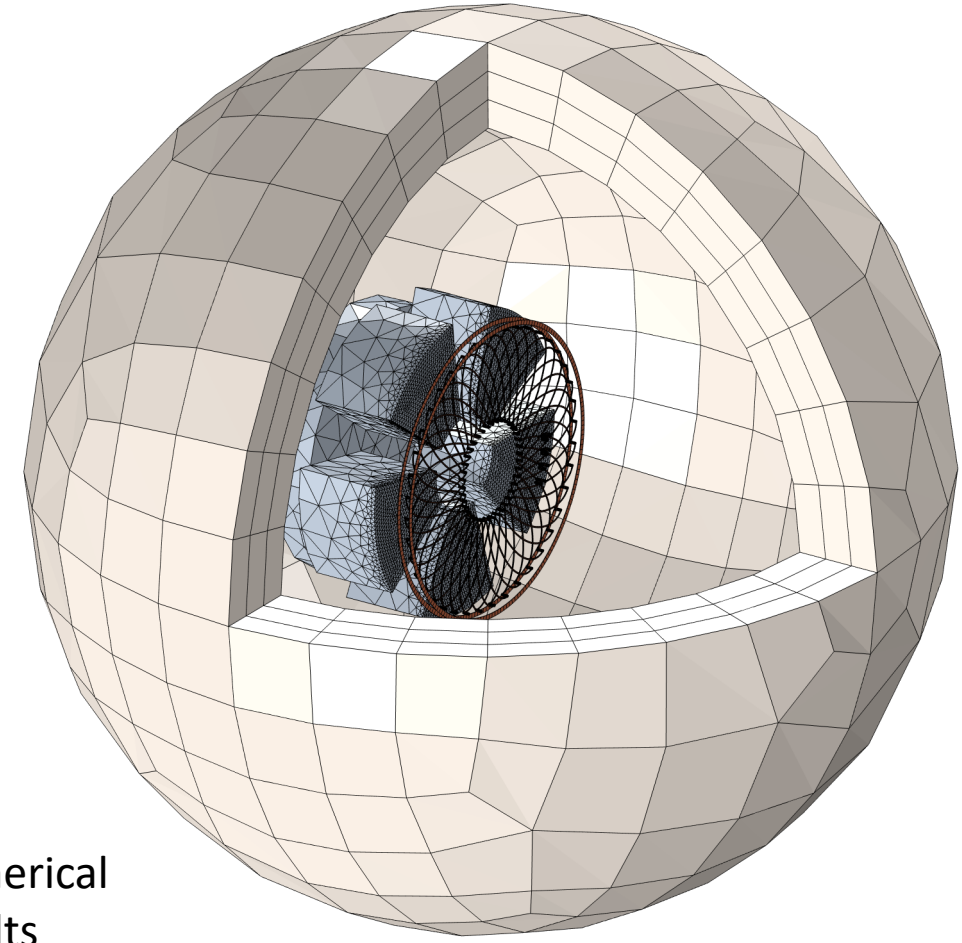
II. Modelling and Numerical Model

CONTINENTAL test bench

Experimental results

Numerical results

Comparison!

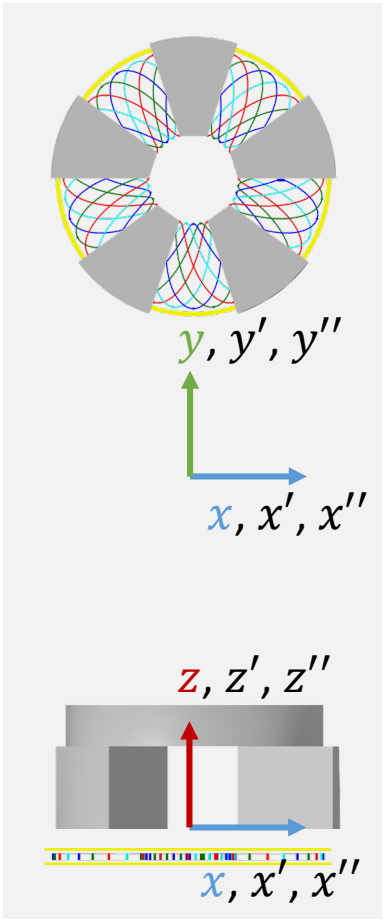


Mesh used for solving

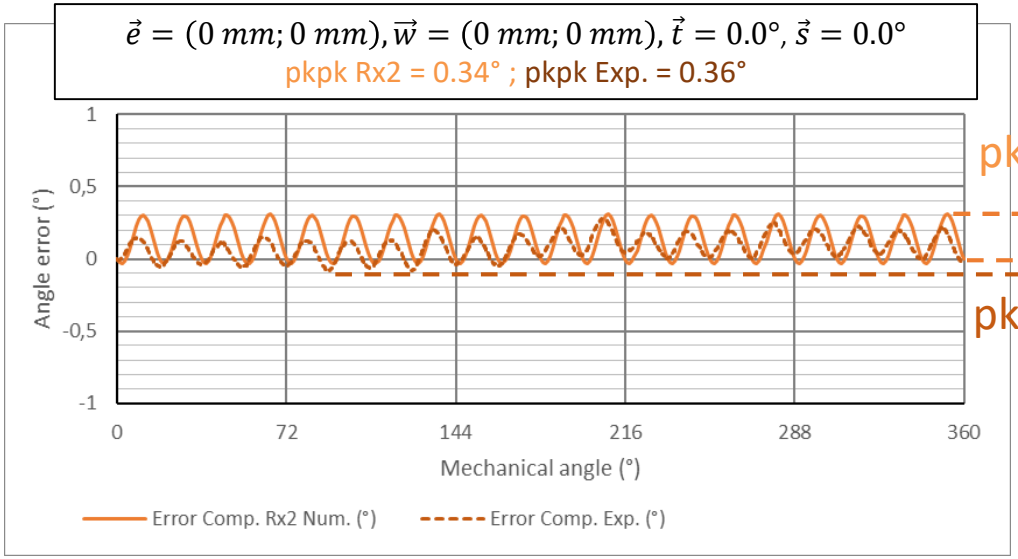
(3.3 M-elements, 50 Go RAM, 15h on 4 processors)

III. Main Results

$$Angle\ error = \alpha_g - \alpha_c$$



Nominal

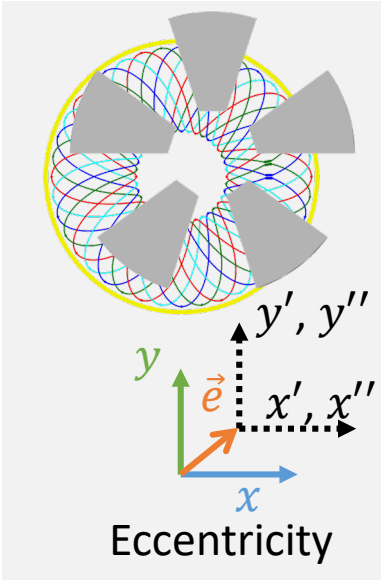


Angle error in **nominal** configuration

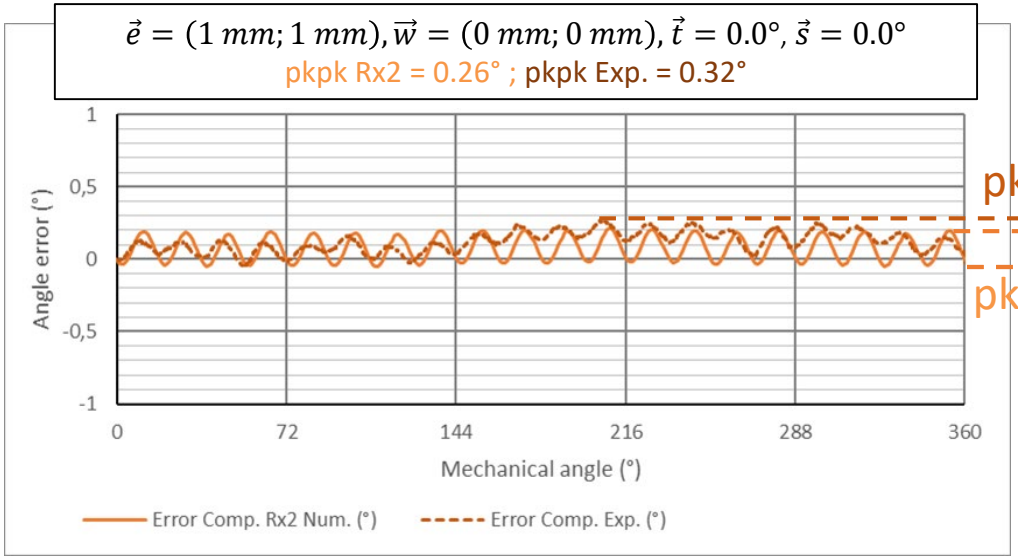
→ Very high precision!

III. Main Results

$$Angle\ error = \alpha_g - \alpha_c$$



Eccentricity

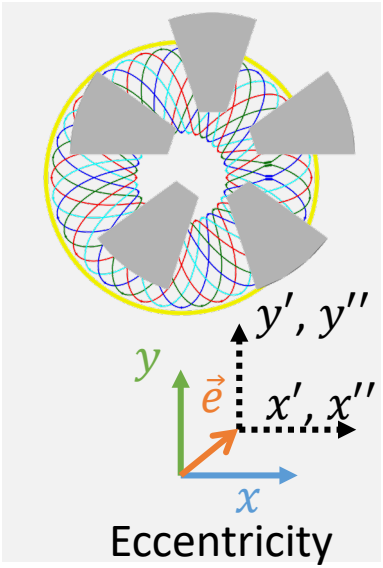


Angle error in **eccentricity** configuration

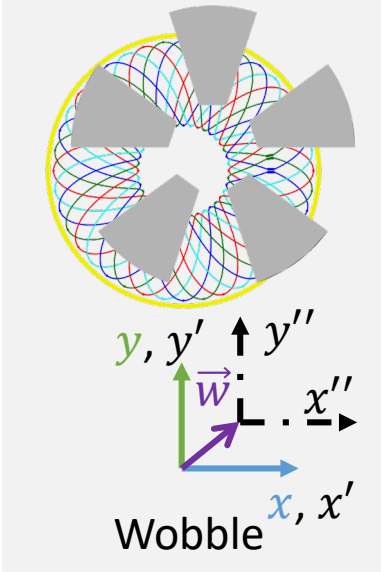
→ Very high precision!

III. Main Results

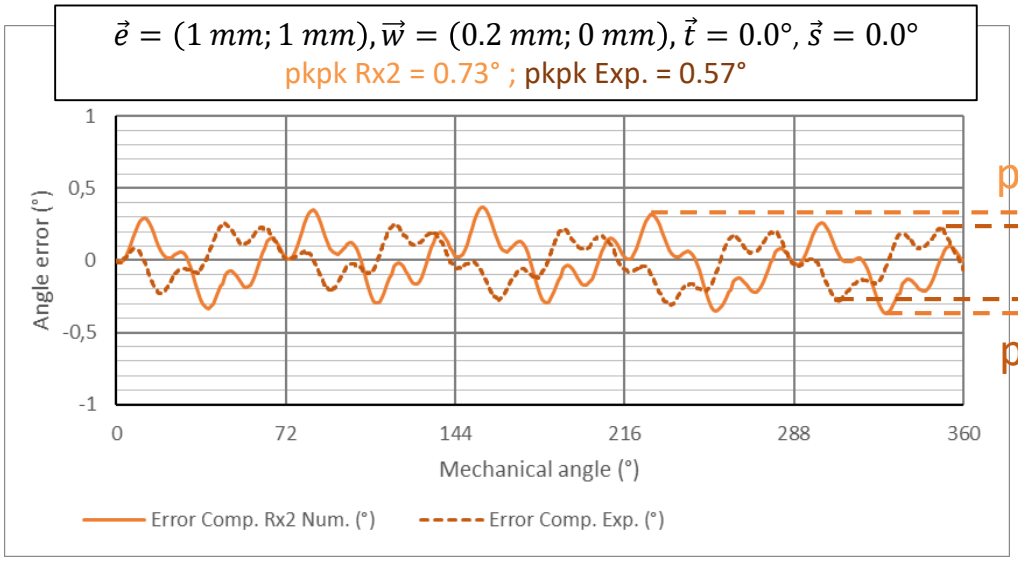
$$Angle\ error = \alpha_g - \alpha_c$$



Eccentricity



Wobble



Angle error in **eccentricity + wobble** configuration

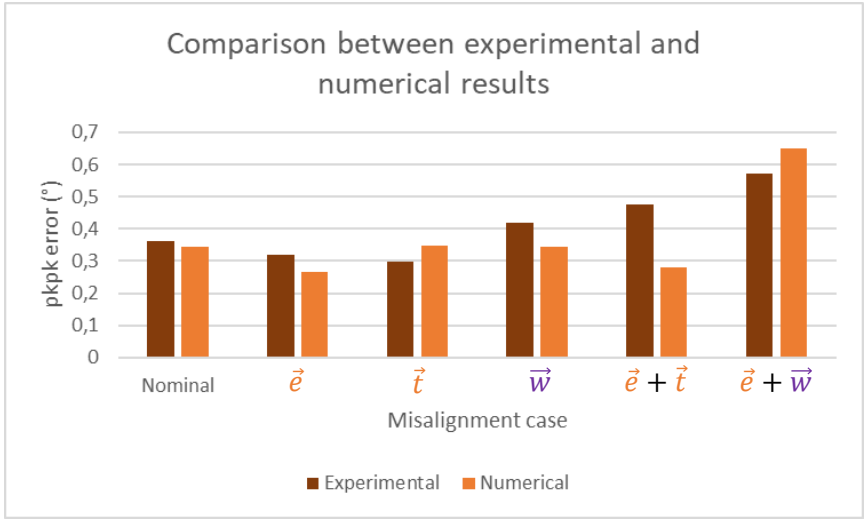
→ Very high precision!

IV. Conclusions - Perspectives

- COMSOL Electromagnetism model developed:
  - Maxwell equations (Vector magnetic potential + Scalar magnetic potential)
  - Rotating domain
  - Fine geometrical details
  - Demanding mesh requirements
  - High solver precision
- Experimental measurements performed
- Successful Numerical-Experimental comparison

→ New design numerical testing abilities: physics-based decision support!

→ Selection of the best designs



To finish…

Thank you!

Q&A?

Our question: What about a coffee to discuss your topic? ☺







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