Towards a new ball bearing cage to address cage instability

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THE LINK BETWEEN THESE PROGRAMS?...

...CAGE INSTABILITY!

- *Under certain circumstances, the cage exhibits dynamical instabilities*
  - *Impacts of the cage with the rolling elements or the rings may lead to an erratic behavior*
    - *Thus significant increase in the bearing power losses and also in the frictional bearing torque*
      - *Space applications have been highly concerned by cage instabilities for the last decades*

GOES

Rosetta

Space Shuttle

Skylab

Cassini-Huygens

XMM-Newton

SoHo

DANGER: CHAOTIC PROBLEM!

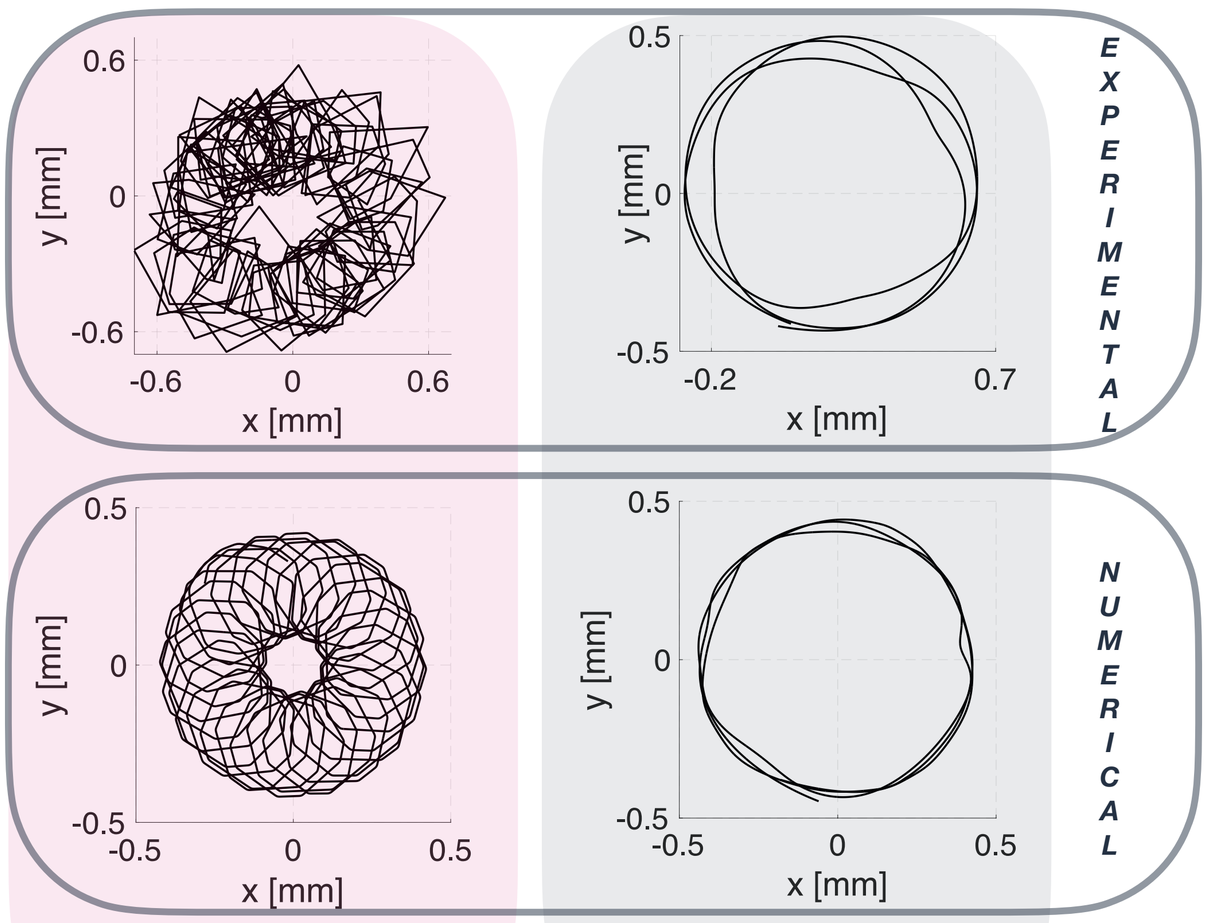
- *Similar to the "Butterfly effect" described by Lorentz, when trying to explain the chaotic nature of the climate*
  - *Impossible to predict **when** an instability will occur*
    - *Does it mean that information cannot be extracted from a chaotic model? **NO!***
- *The purpose is not to predict **where** and **when** a cage instability will appear but to explain **why** it will happen, in order to prevent any occurence*

SUCCESSFUL DEVELOPMENT OF A CAGE MODEL

- *Highly nonlinear*
- *Original integration scheme of the set of equations*
- *Easy to use with regard to the complexity of the problem*
- *Identification of the deep nature of cage instability*

- *Both stable and unstable phases have been successfully reproduced **numerically** and **experimentally***
- *Unstable phases have been confirmed by high intensity and high frequency perturbations in the bearing torque*
- *For more information, please see our related paper!*

Examples of cage center trajectories



INSTABILITY ***STABILITY***

STRONG ADDED VALUE FOR THE EUROPEAN SPACE COMMUNITY

- *Connection between the new cage model and the ESTL's software CABARET in progress*
- *Intensive use of the cage model led to a new cage design (patent pending), which is **intrinsically stable***

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