Generation of Asymmetric Incommensurable Torque Signals

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Agenda

1. Introduction
   - Motivation: Search of New Energy Harvesting Sources
   - Classical Kinetic Energy Harvester (KEH) Concepts
2. New Class of KEH System
   - Background
   - Setups
   - Verifications
   - Simulations
3. Conclusions and Outlook

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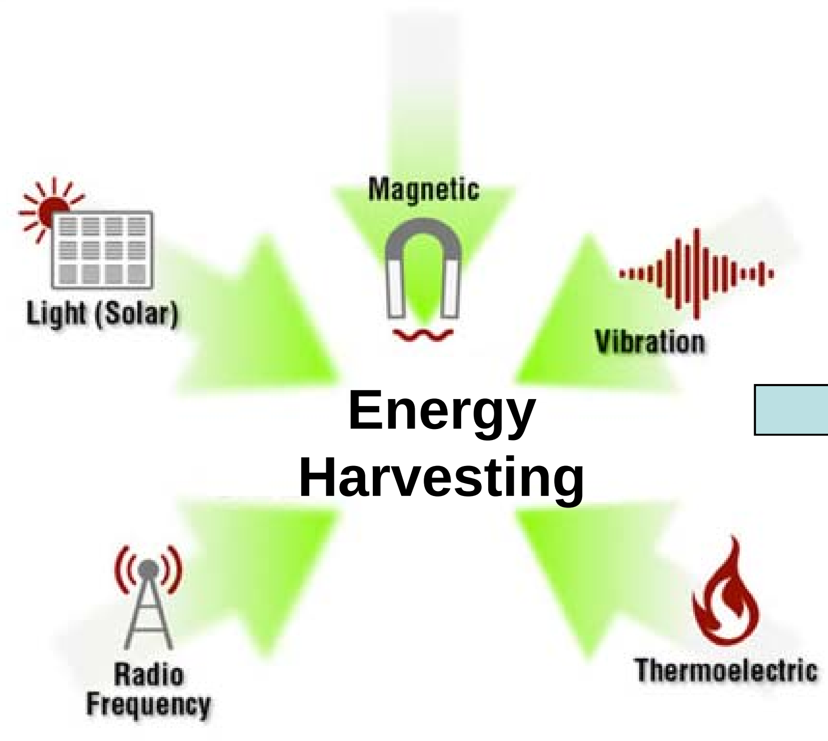
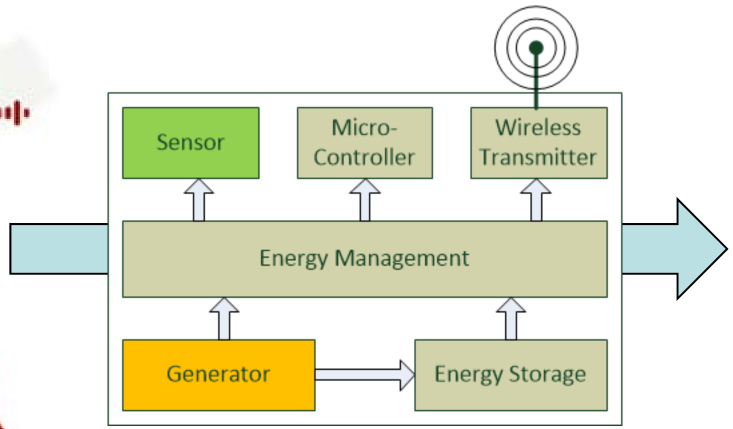
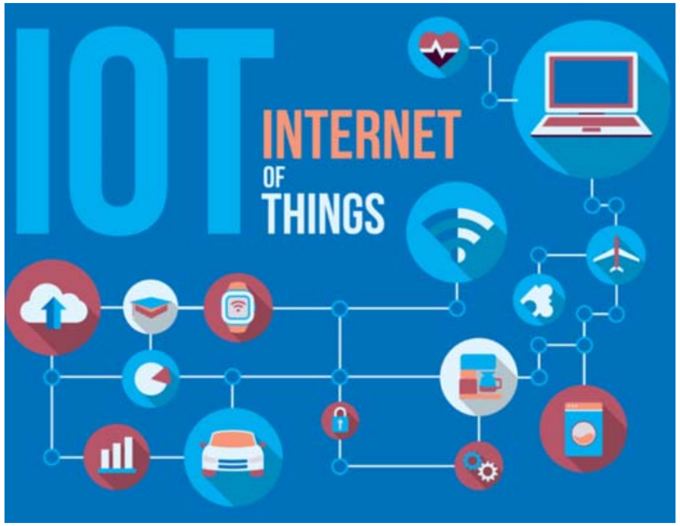
Introduction

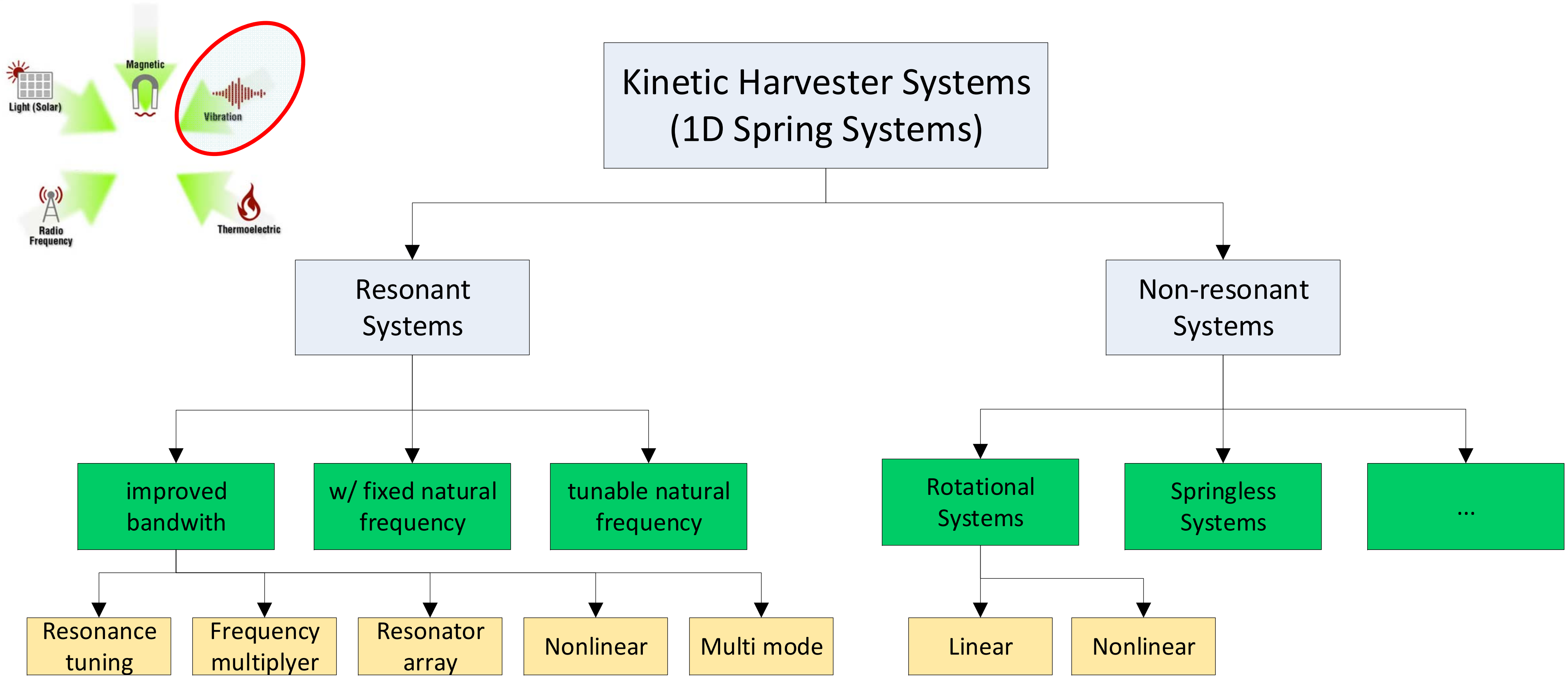
Energy Harvesting (EH) – Unconventional Generation of Electrical Energy







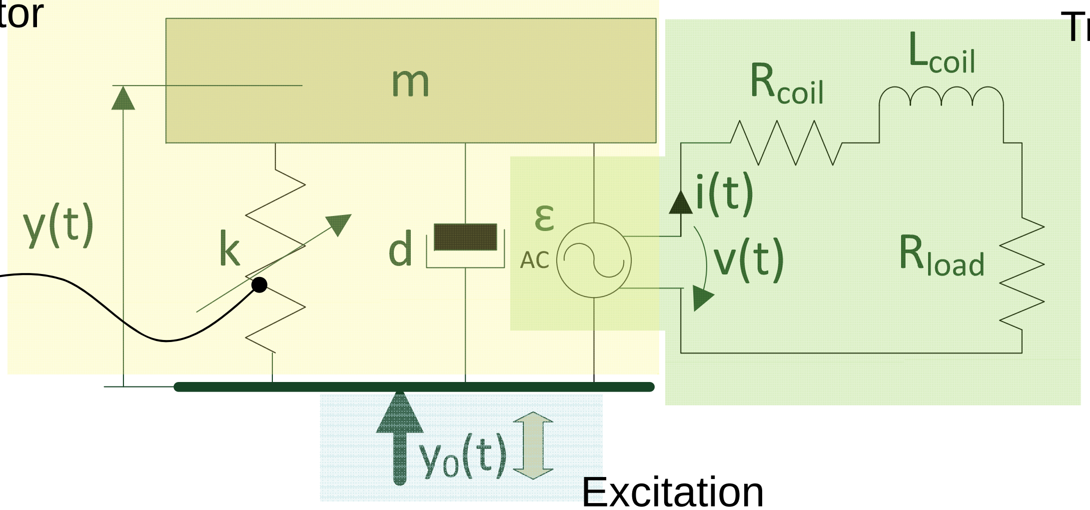
Classification of Kinetic Harvester Systems



Classical Concepts of Resonant Kinetic Energy Harvesting (KEH) – Nonlinear Spring

Mechanical Oscillator

Transducer



Excitation

$$F_S(y) = k\,y + \underbrace{k\,\mu_{NL}}_{k_n} y^n$$

$$\beta = \frac{k}{k_n} A^{n-1}$$

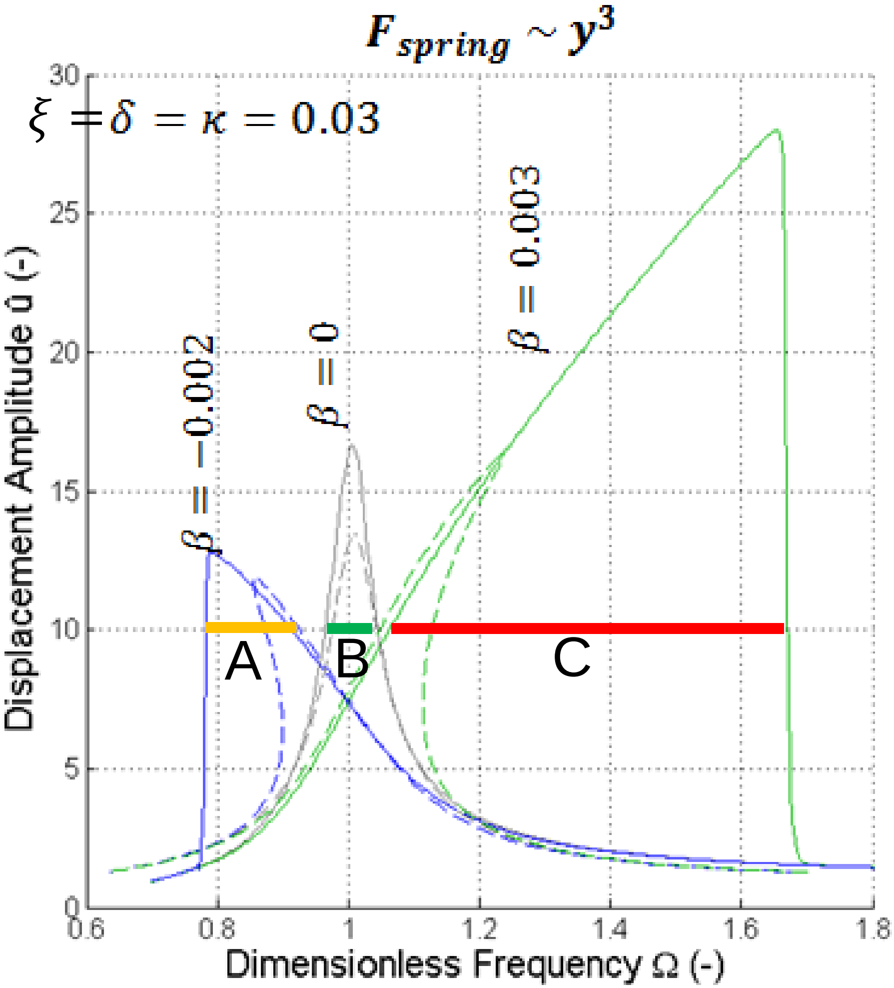
$$\kappa = \frac{\varepsilon^2}{L_{coil}\, d\, \omega_1} \qquad \lambda = \frac{R_{coil} + R_{load}}{L_{coil}\, \omega_1}$$

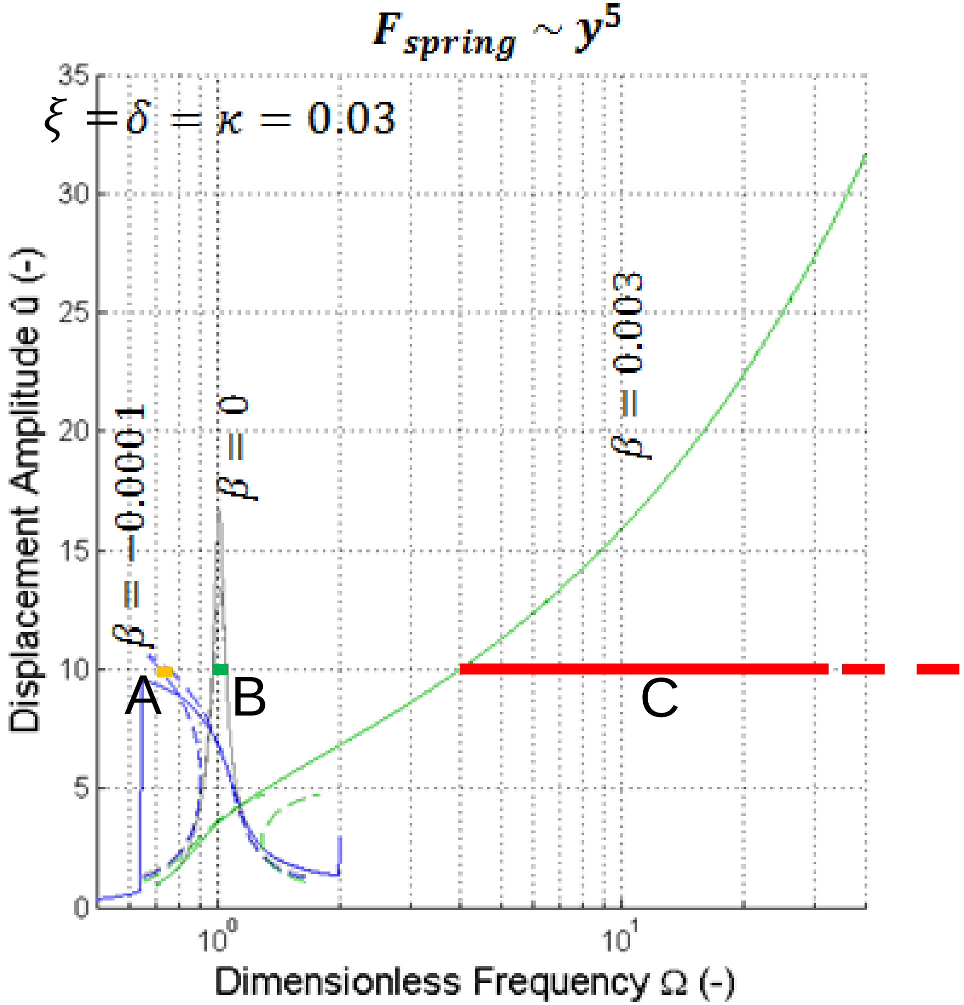
$$y(t) \xrightarrow{\tau = \omega_1 t} z(\tau) \qquad \xi = \frac{d}{2\sqrt{k\,m}} \qquad \omega_1 = \sqrt{\frac{k}{m}} \qquad \Omega = \frac{\omega}{\omega_1}$$

$$z''(\tau) + \xi\, z'(\tau) + z(\tau) + \beta z^n(\tau) + \kappa\lambda\zeta(\tau) = -\Omega^2 \cos\Omega\,\tau$$

$$\kappa z(\tau) = \zeta'(\tau) + \lambda\zeta'(\tau)$$

Improvement of Resonance Bandwidth





A: Nonlinear Softening B: Linear C: Nonlinear Hardening

New Class of KEH System

Patent “Device having an arrangement of magnets” WO/2009/019001 / PCT/EP2008/006459

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Date
November 26th, 2016

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Our reference

Subject
Declaration

Declaration

Herewith I – Ton Backx – declare that I have seen the permanent magnet based motor, developed and built by mr. Muammer Yildiz, running for a significant period of time driving a fan. The actual power delivered has not been registered during this demonstration.

After the motor has been running for more than one hour with presence of several witnesses and recorded on video mr. Muammer Yildiz opened the motor completely to reveal to me its construction and the materials applied completely.

The motor is built with well-ordered permanent magnets fixed in an aluminum based rotor and stator. Specially configured additional permanent magnets together with bars of magnetic material (iron) are used for control of the rotation speed and the power delivered by the motor. Some of the magnets have been fixed in disks made of plastic instead of aluminum. In the motor that was completely opened all permanent magnets are fixed both in the rotor and in the stator by means of bolts. The positioning of these permanent magnets is very critical for the functioning and the performance of the motor. No other materials have been used in this motor. The motor does not have any space left for a hidden source of energy to supply the energy needed to keep the motor running. The motor furthermore does not contain any coils or antenna's.

This motor is a very interesting device that deserves to be subject of fundamental research to investigate the way it converts energy from an external source of energy to mechanical energy by means of well-structured configurations of permanent magnets.

EINDHOVEN UNIVERSITY OF TECHNOLOGY TU/e DEPARTMENT OF ELECTRICAL ENGINEERING

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To enable further development to application of the motor a next set of experiments needs to be done in which it will be proven that the motor is not converting energy of a well-known source of energy (e.g. battery, hydrocarbons, other energy source with high energy density, nuclear power source, …) to mechanical energy. The set of experiments proposed are experiments where the motor will deliver accurately registered power during sufficiently long time that with the volume of the motor not publicly revealed cannot store the amount of energy delivered even if conversion would be with 100% efficiency.

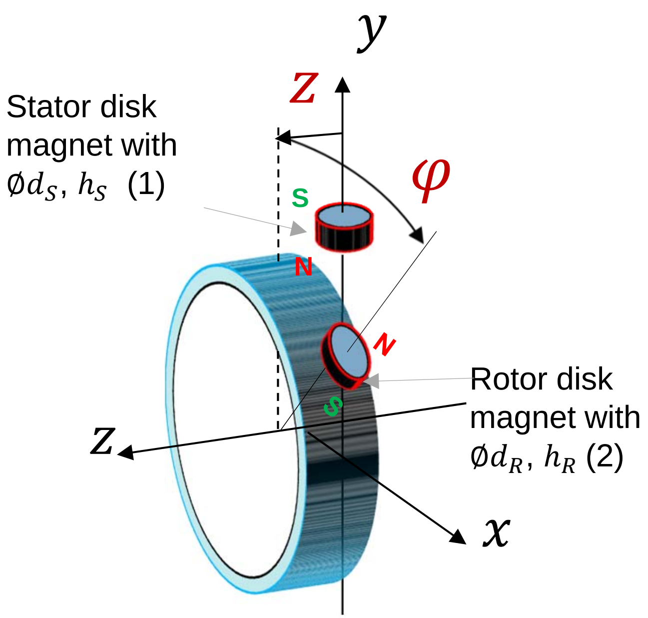
Prof.dr.ir. Ton Backx
President Institute for Photonic Integration

Witnesses:

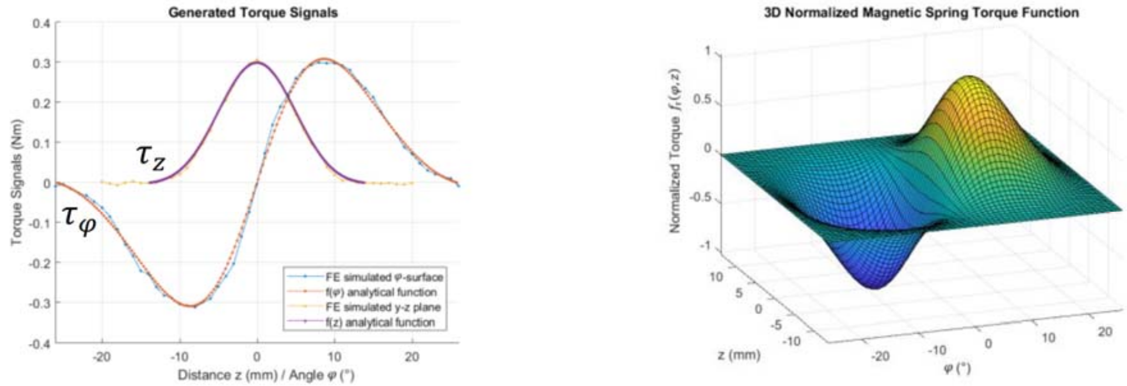
Dr. Jorge Duarte
Assistant professor
Electrical Engineering

Taco W. Neeb
Director Tendris Solutions bv

2D Permanent Magnet Spring Model I, II

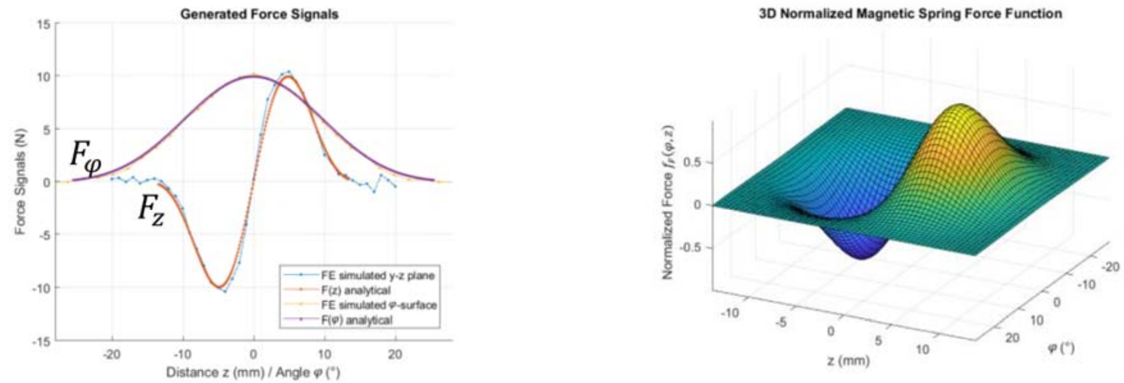


2D Spring Torque



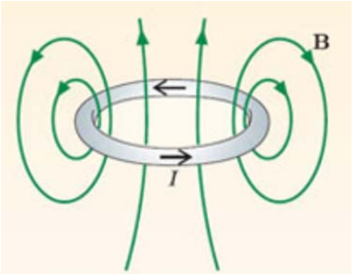
(a) (b)

2D Spring Force



(a) (b)

2D Permanent Magnet Spring Model III



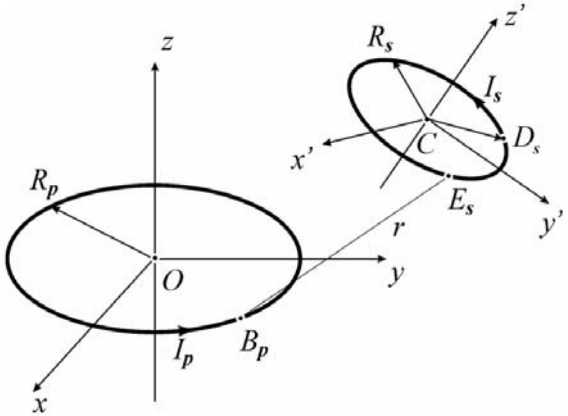
Current ring

$\approx$

Ring PM

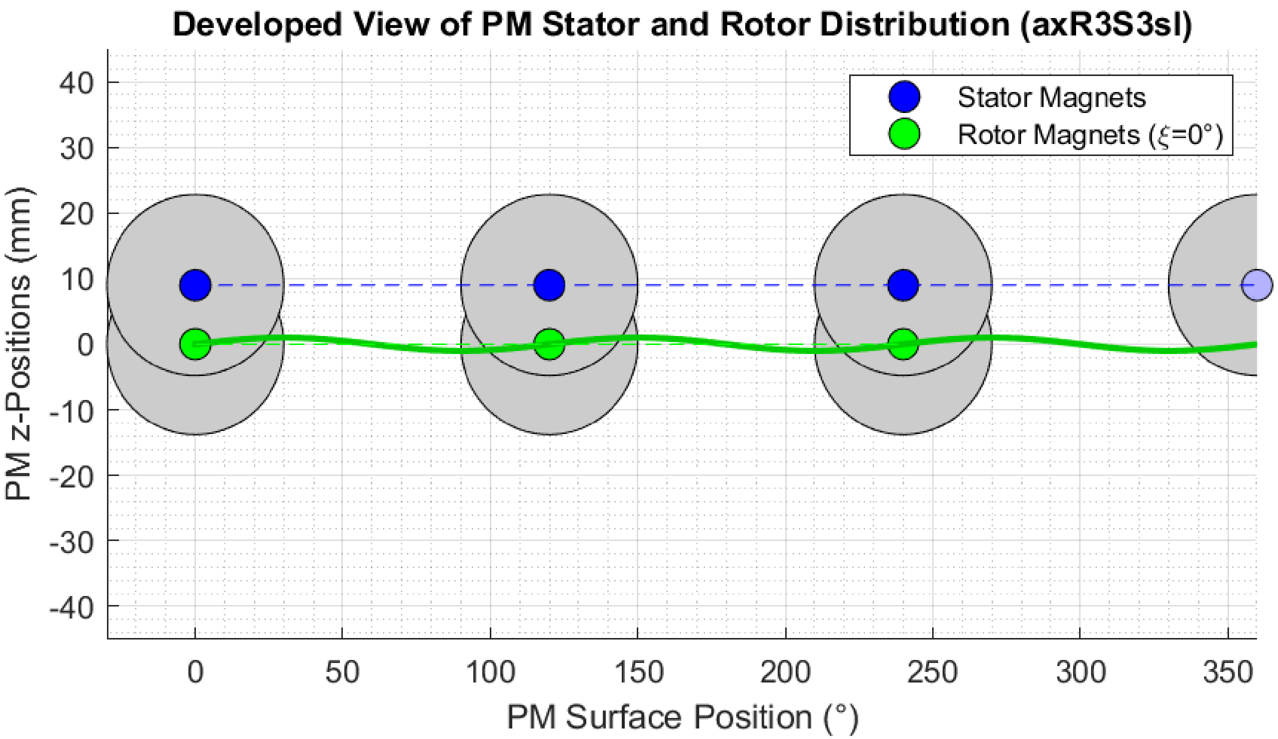
$\approx$

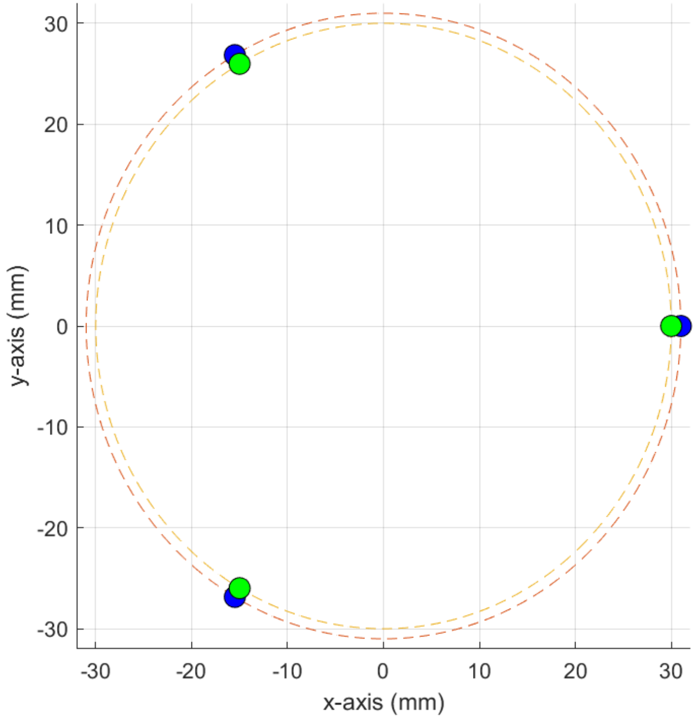
Disk PM



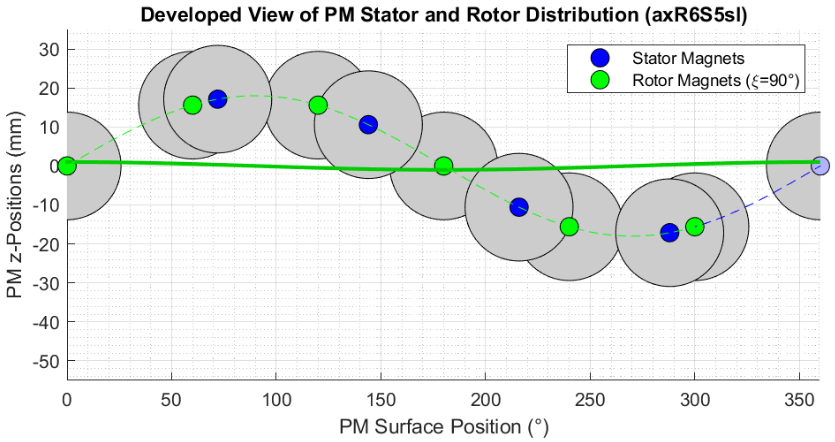
$$\mathbf{F}_{\mathbf{mag}} = I_S \oint_C d\mathbf{l}_S \times \mathbf{B}_{\mathbf{P}}(\mathbf{l}_S)$$

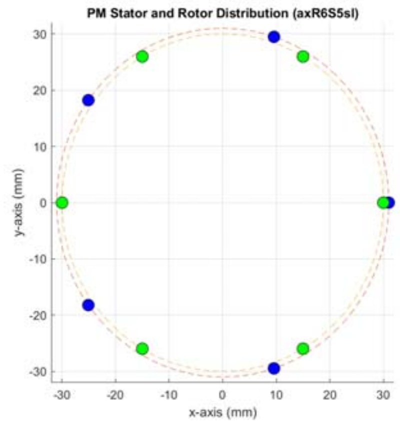
Exemplarily Stator-, Rotor-PM Configuration

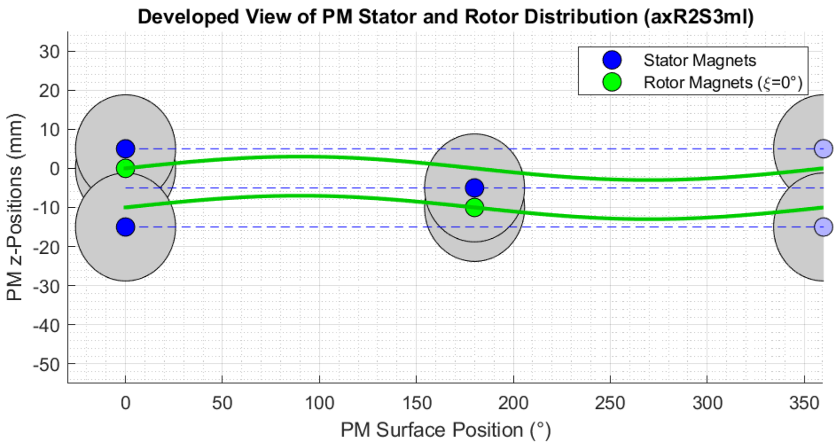


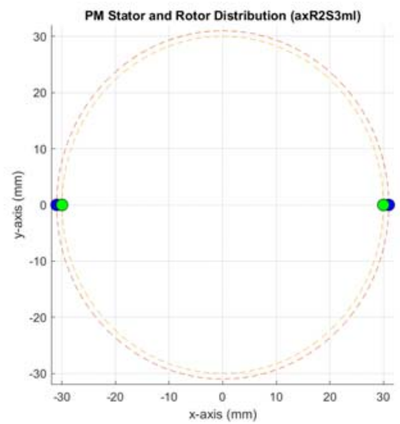


Tests of a Variety of Stator-, Rotor-PM Configurations

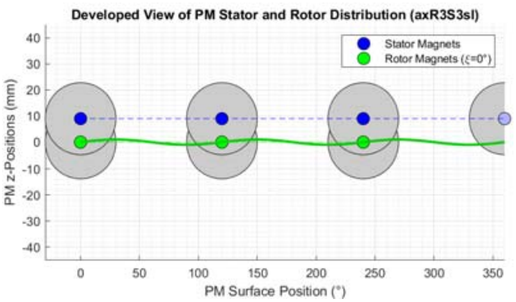




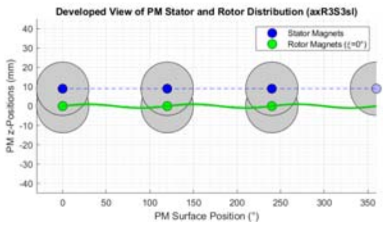


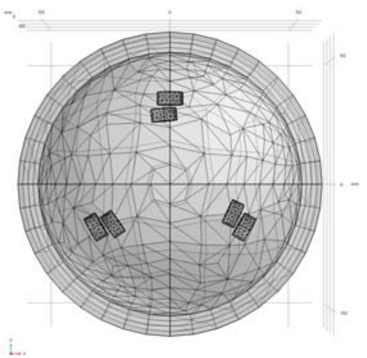


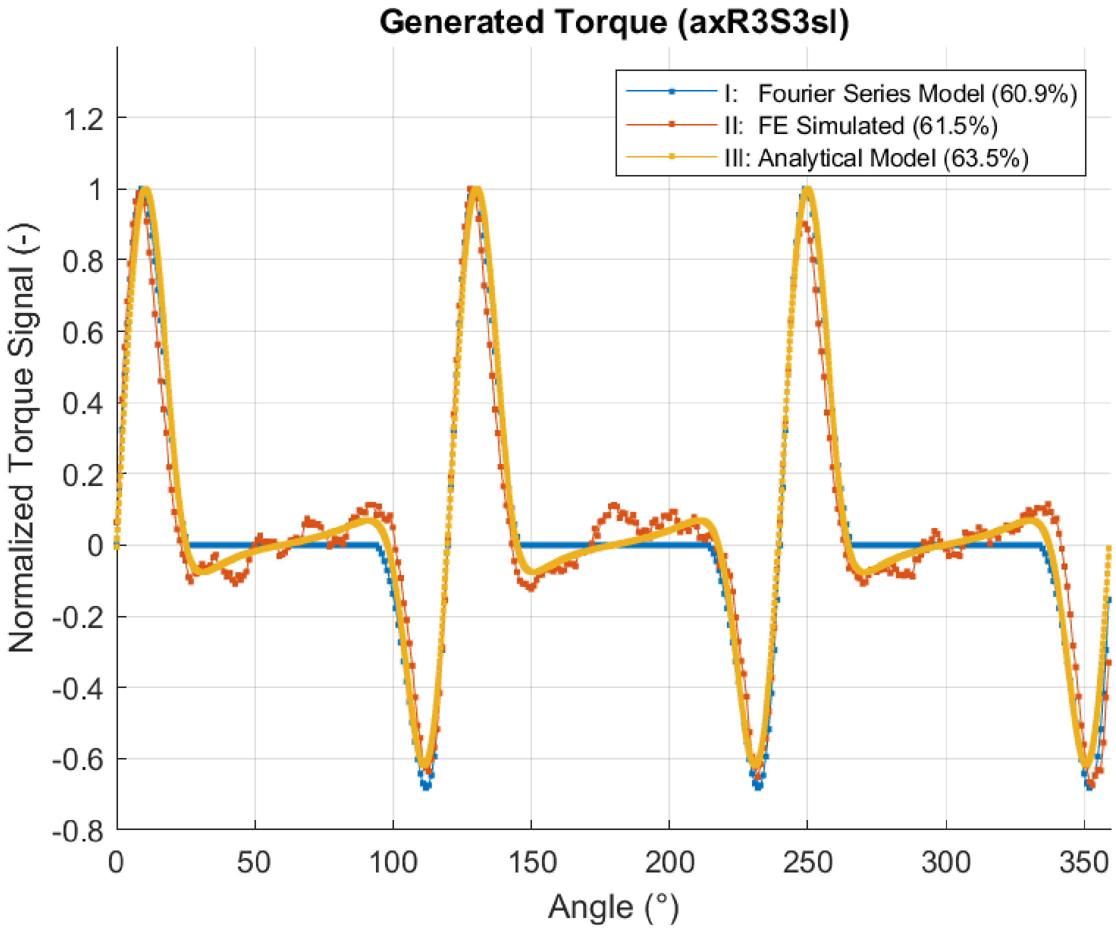
Maximizing of Asymmetric Torque



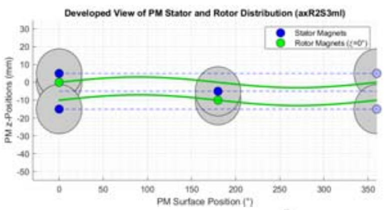
Asymmetric Torque (Variant axR3S3sl)

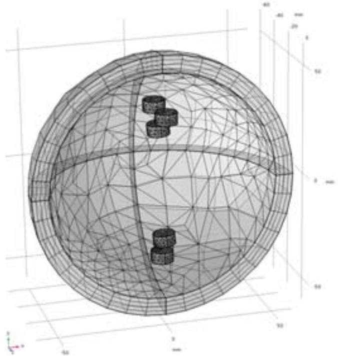


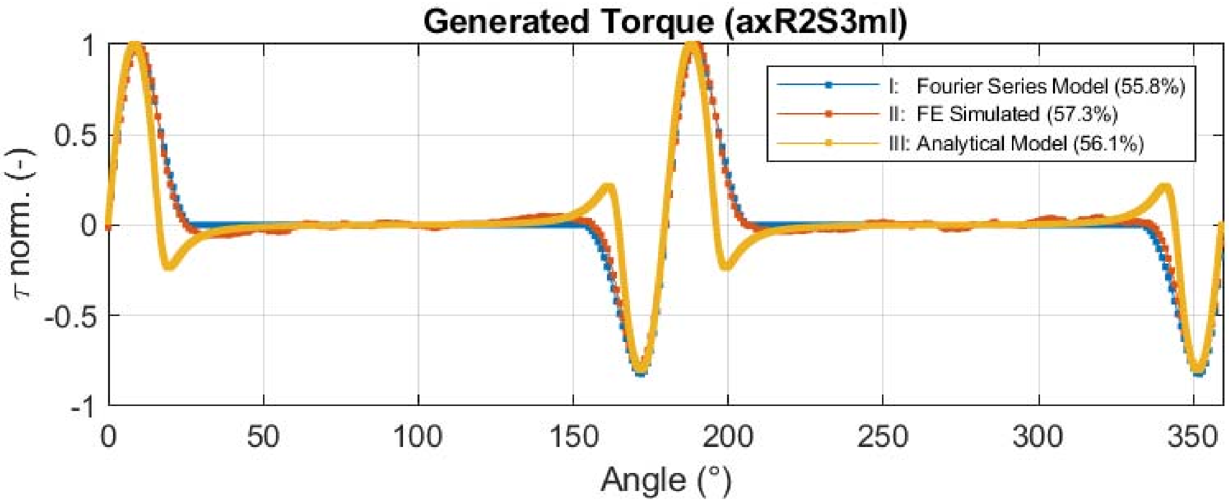




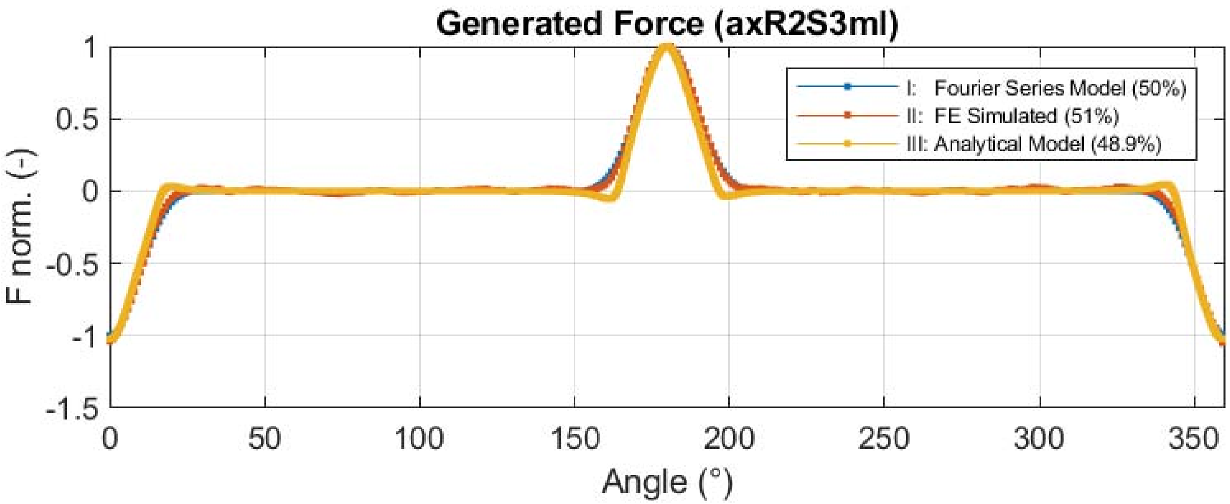
Asymmetric Torque (Variant axR2S3ml)







Desired asymmetric torque



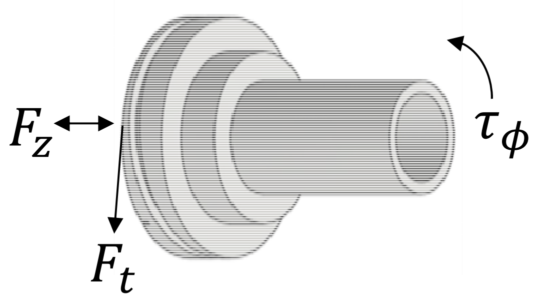
Produced lateral force

Mechanical Energy

$$\underbrace{\mu_{rad} = 0}_{\text{Min. friction}} \qquad W_\phi = \int_0^{2\pi} (1 - \mu_{rad})\tau(\phi)\, d\phi \cong 46.1mJ$$

$$W_z \cong \int_0^{2\pi} \mu_{ax} |F(\phi)|\, z_R(\phi)\, d\phi \cong 0$$

$$\underbrace{\mu_{ax} = 1}_{\text{Max. friction}} \qquad W_t \cong \int_0^{2\pi} \mu_{ax} \underbrace{|F(\phi)|}_{\cong F_N} r_{cam}\, d\phi = 234.6mJ$$



Total energy: $W_{tot} = W_\phi - (W_z + W_t) = -188.4mJ$ ⟺ $W_{mag} = \int \mathbf{F_{mag}} \cdot d\mathbf{l} \neq 0$

Damping Lateral Mechanical Energy

The produced energy ($W_z + W_t$), e.g. force F_z, F_t can be damped!

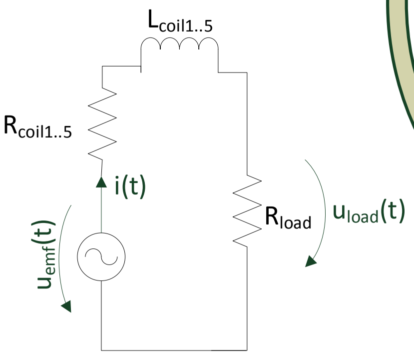
$$F_{fcam} = \mu\, F_N \cong \mu\, F_z$$

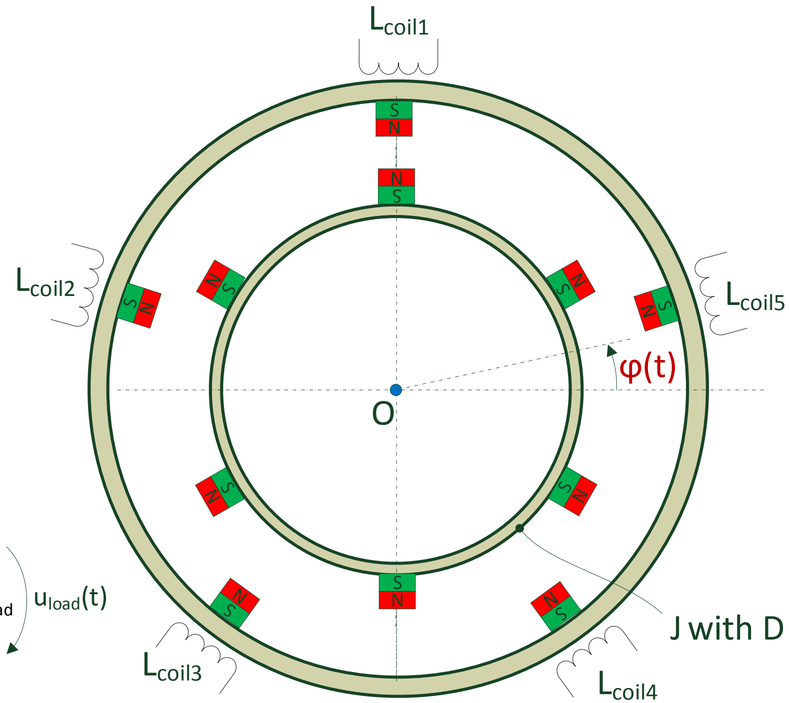
Note: Over one revolution assuming harmonic movement

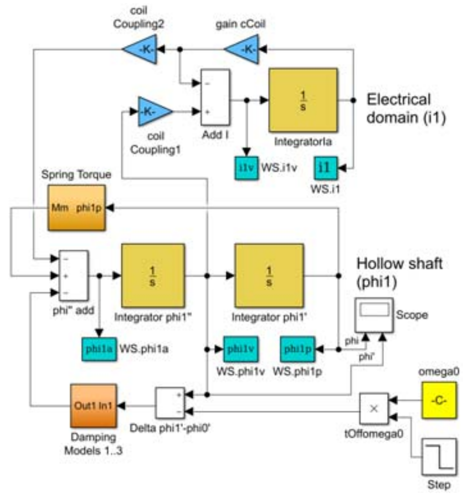
If the produced energy ($W_z + W_t$) is damped by a factor 4.1x…

$$W_\phi > W_z + W_t$$

Mathematical-Physical Model (Non-Resonant)







$$J_R\,\varphi'' + D_\varphi \varphi' + \varepsilon\, i \;= T_{mag}\, f_T(\varphi)$$
$$L_{coil1\ldots5}\; i' + (R_{coil1\ldots5}{+}R_{load})\; i \;= \varepsilon\, \varphi$$

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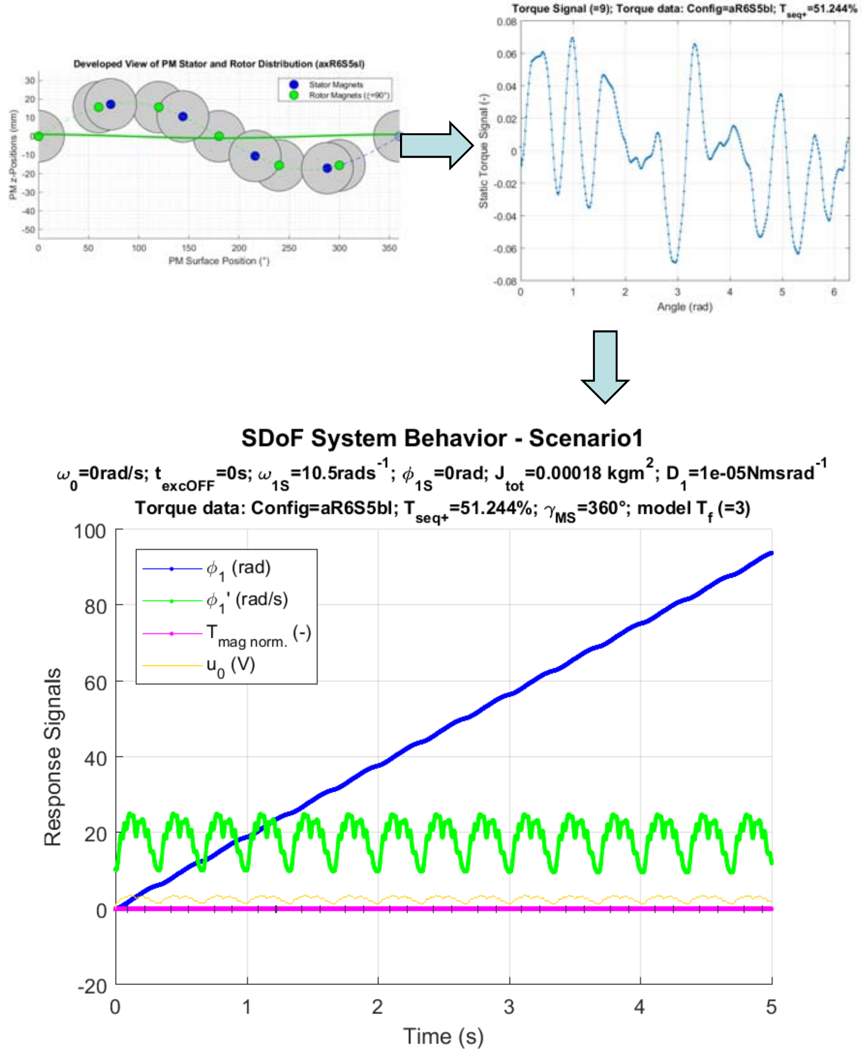
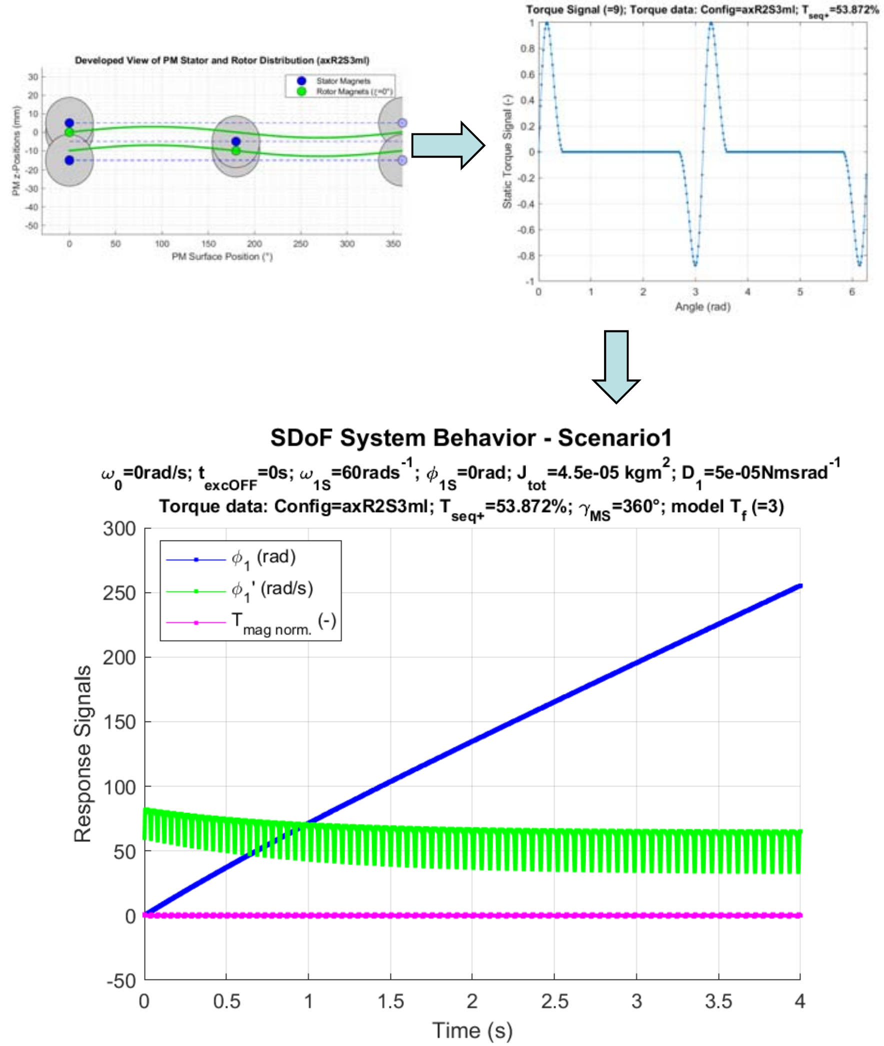
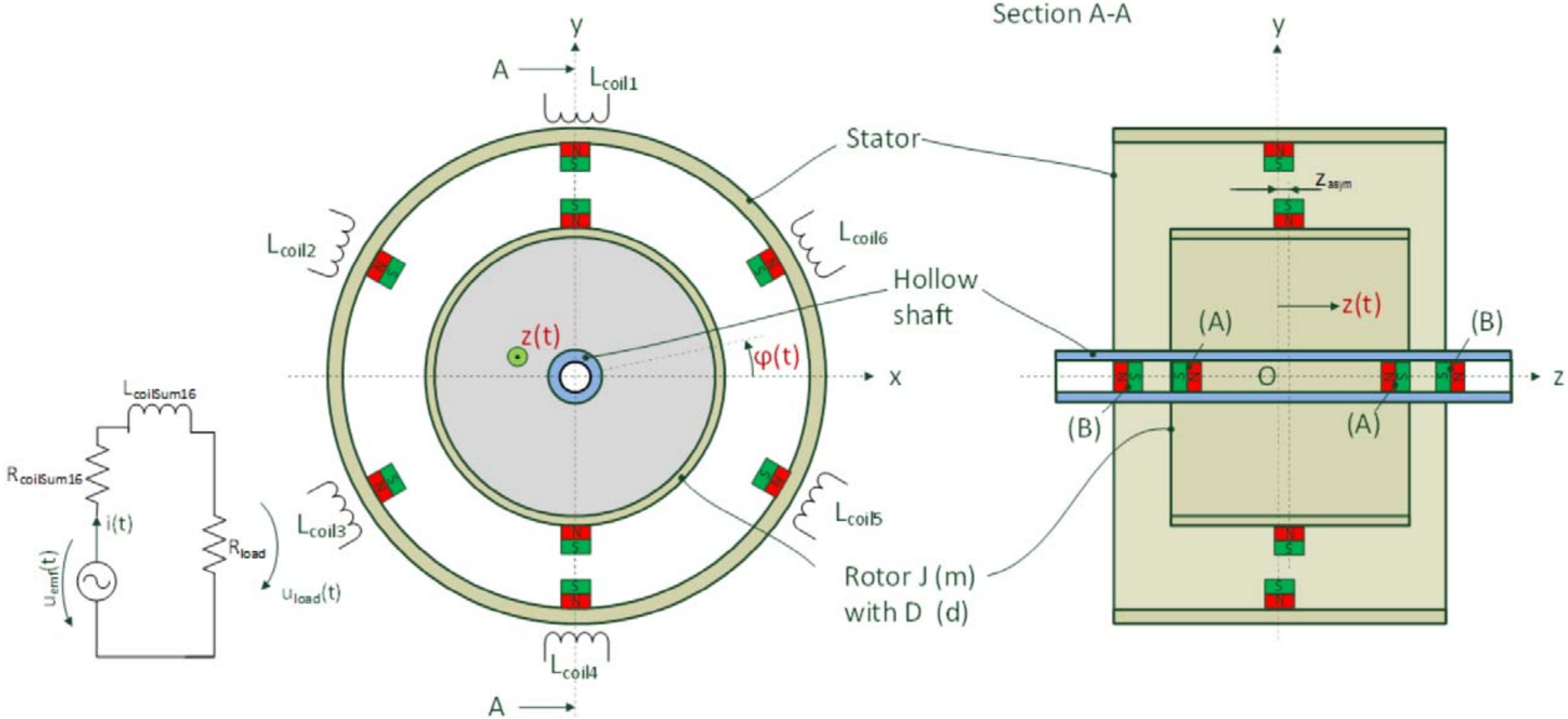
Dynamical Simulations (Non-resonant)





Mathematical-Physical Model (Resonant)

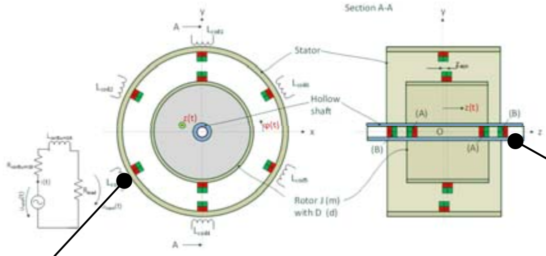


$$J\phi'' + D\,(\phi' - \omega_0) + C_r \sum_{n=1}^{n_{PM}} f_\tau(\phi - \phi_n, z - z_n) + \varepsilon_\phi i = 0$$

$$mz'' + dz' + k_r \sum_{n=1}^{n_{PM}} f_F(\phi - \phi_n, z - z_n) + k_1\,(z - z_{asym}) + k_3(z - z_{asym})^3 + \varepsilon_z i = 0$$

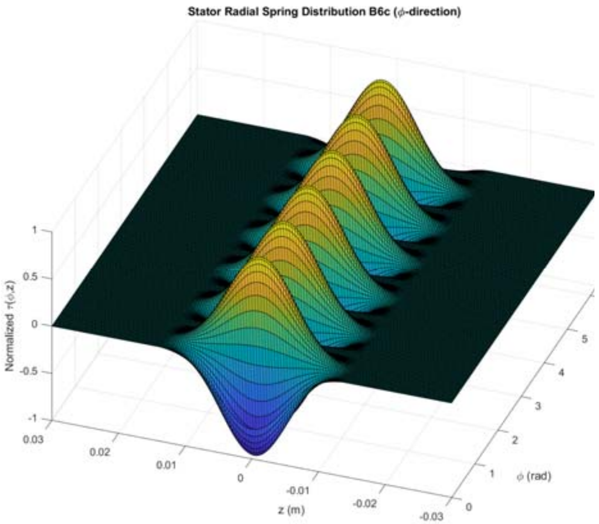
$$L_{coilSum16} i' + (R_{coilSum16} + R_{load}) i = \varepsilon_\phi \phi + \varepsilon_z z$$

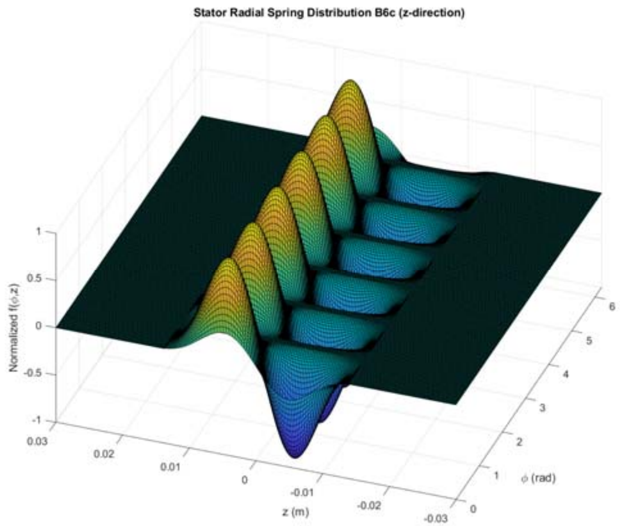
Nonlinear Radial / Axial Stiffness Signals

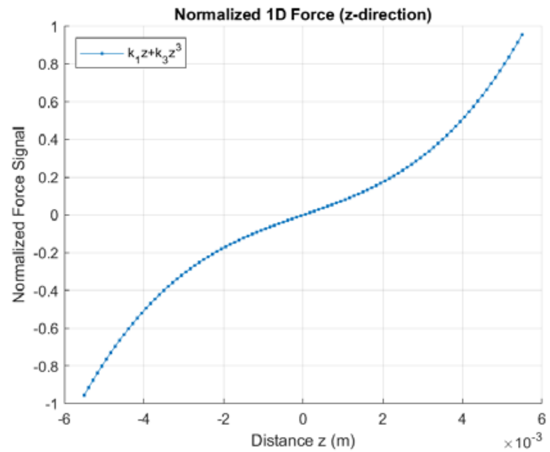


Radial configuration (2D)

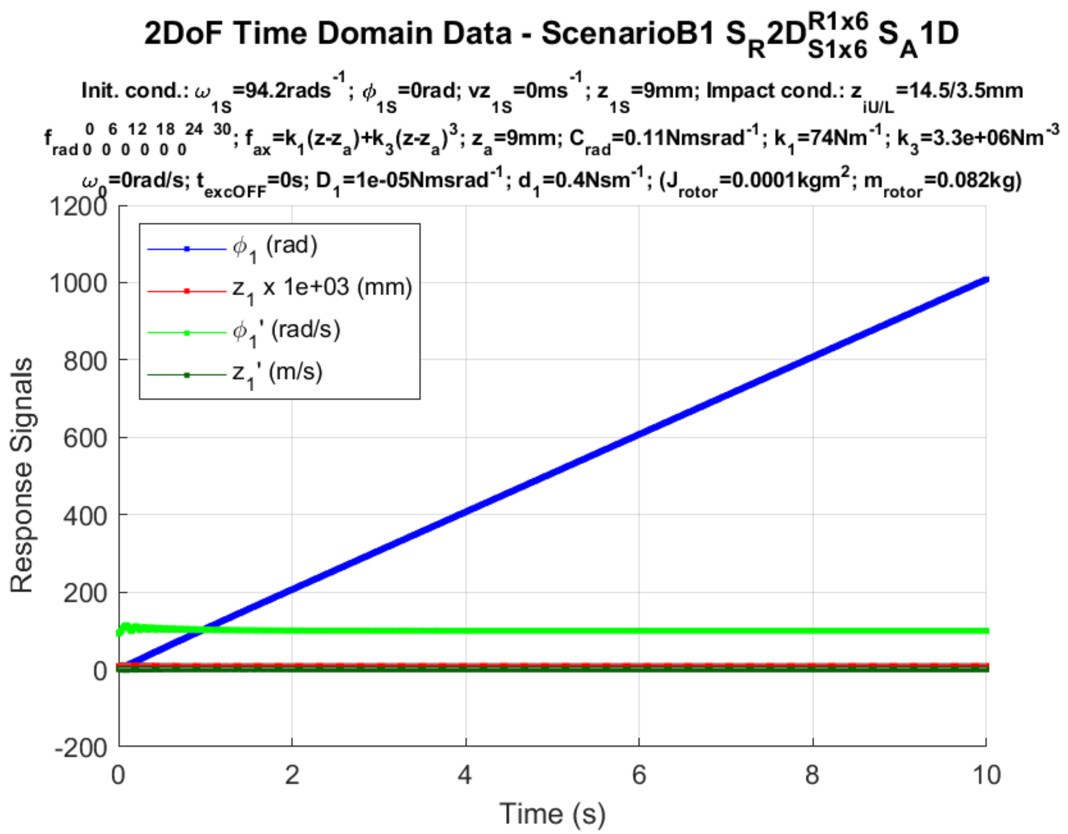
Axial configuration (1D)

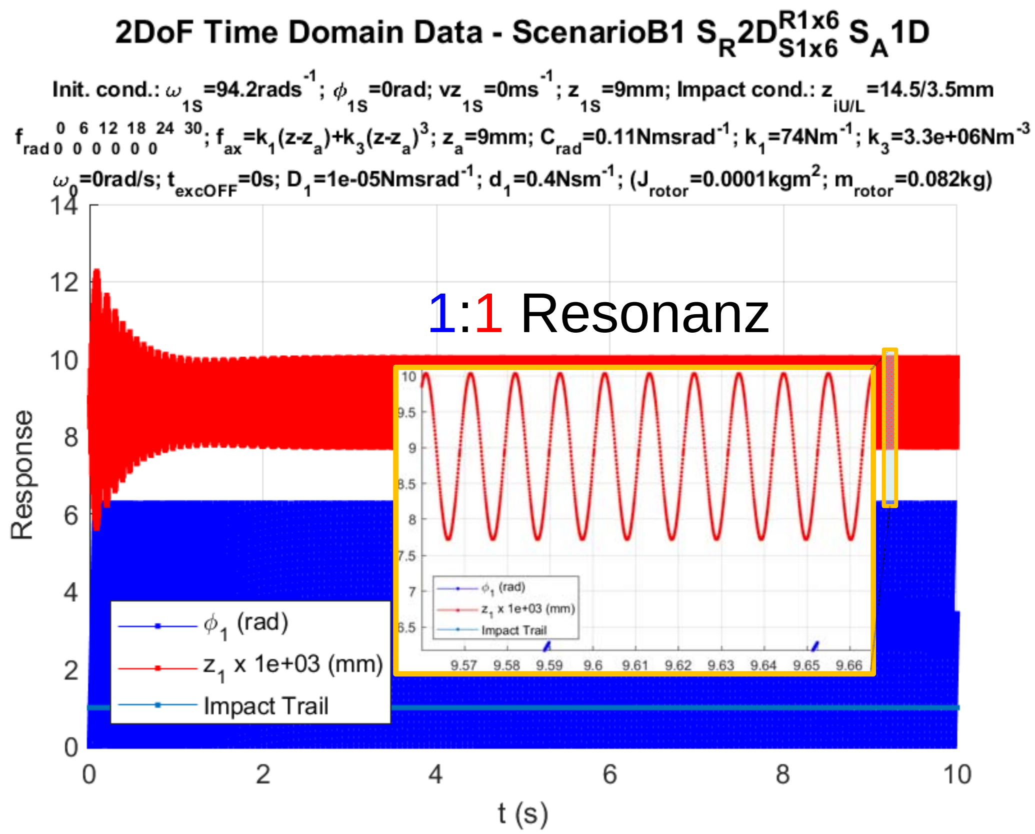






Excerpt of Dynamical Simulations (Resonant)





Conclusions and Outlook

Conclusions

1) Phenomenological approach by investigating the feasibility of a patent like WO/2009/019001 / PCT/EP2008/006459

2) PMs with geometrical extension can do work

3) Where the energy comes from in the microcosm has not been identified in detail

4) PM-springs can be used as non-conservative fields, by clamping initial mechanical energy
   a. and forcing 2DoF rotor trajectories via a cam in a closed loop (non-resonant)
   b. in an autoparametric 2DoF resonator (resonant)

5) By emulating PMs with current loops, the question arises: what energy in the microcosm keeps the current constant ?

Outlook

1) Simpler models are existing (currently IP claims are ongoing)
   - Rotary-radial spring system
   - Cogwheel coupled spring systems (and for instance also Tusi Couples)

2) Investigating this phenomenon in the microcosm – it might be useful to study carefully also new atom models like the one from R. Mills

3) Nullius in Verba – an open source experiment is indispensable!

Thank you for your attention

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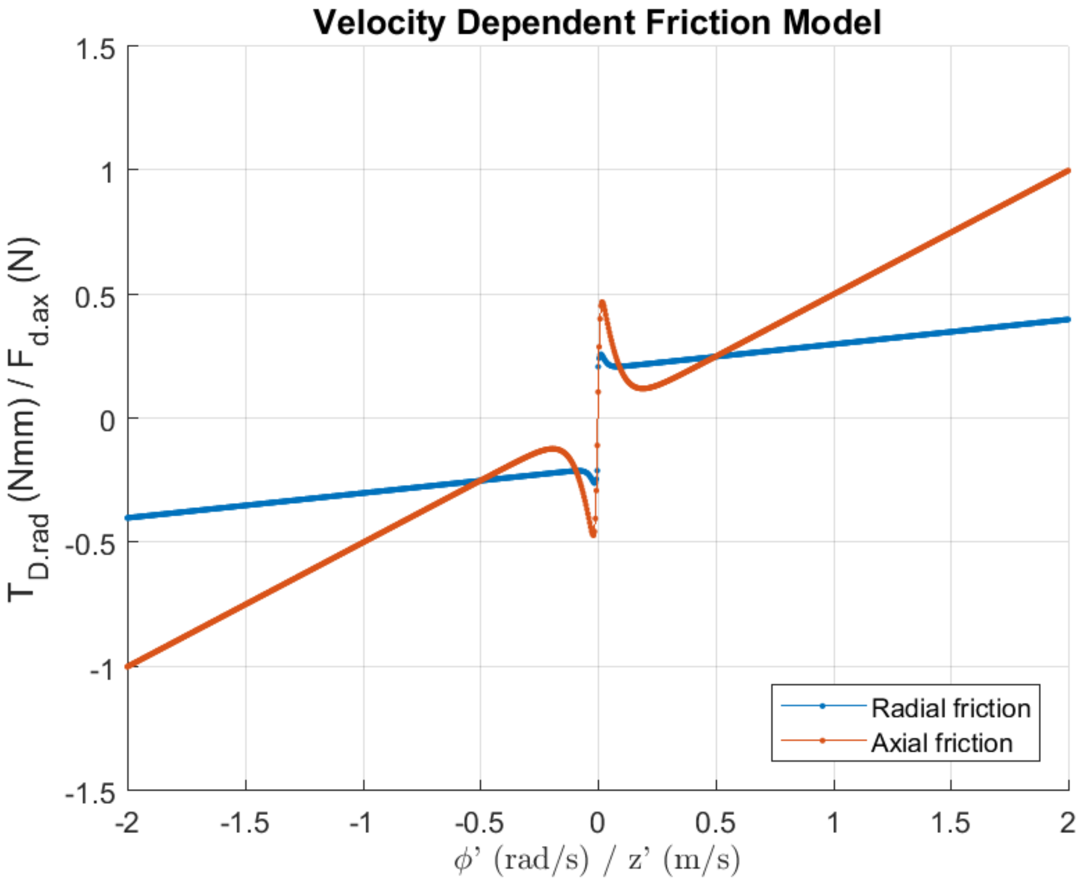
Backups

Nonlinear Friction Model



Cam-Based Harmonic Lateral Dynamics