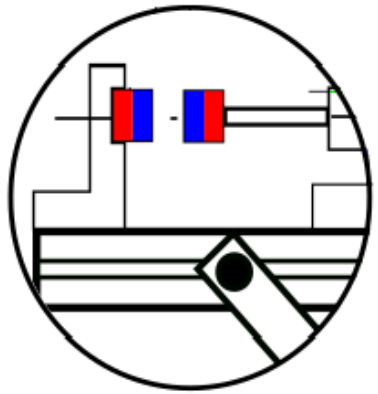
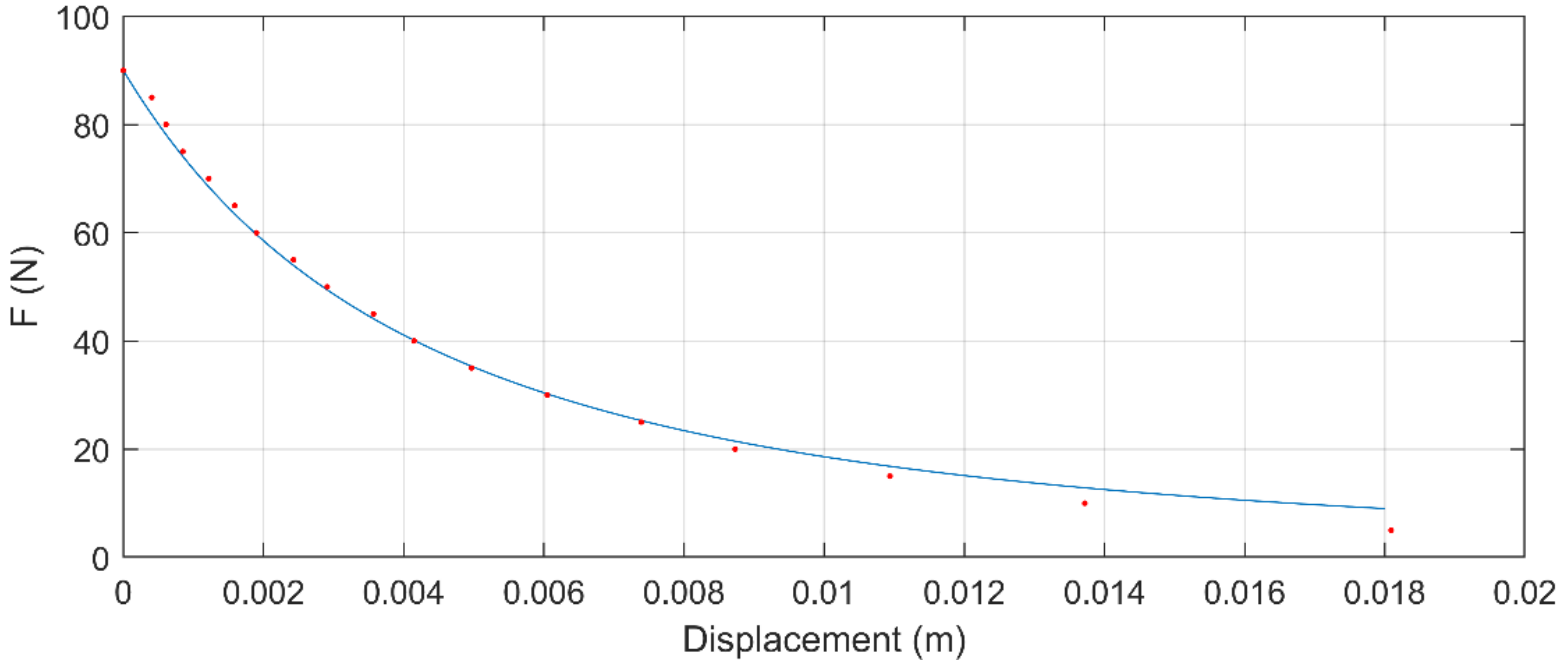
Matematyczny model osiowej sprężyny magnetycznej oraz wpływ jej parametrów na charakter sztywności

Maksymilian Bednarek

24.03.2026

Siła pomiędzy magnesami

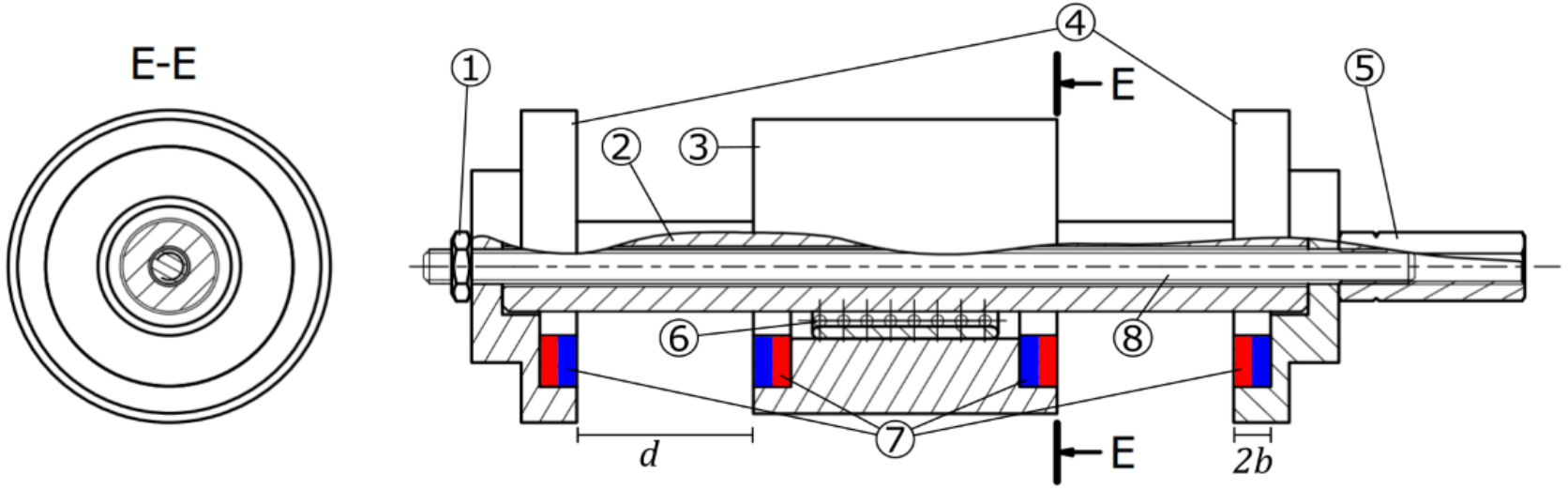


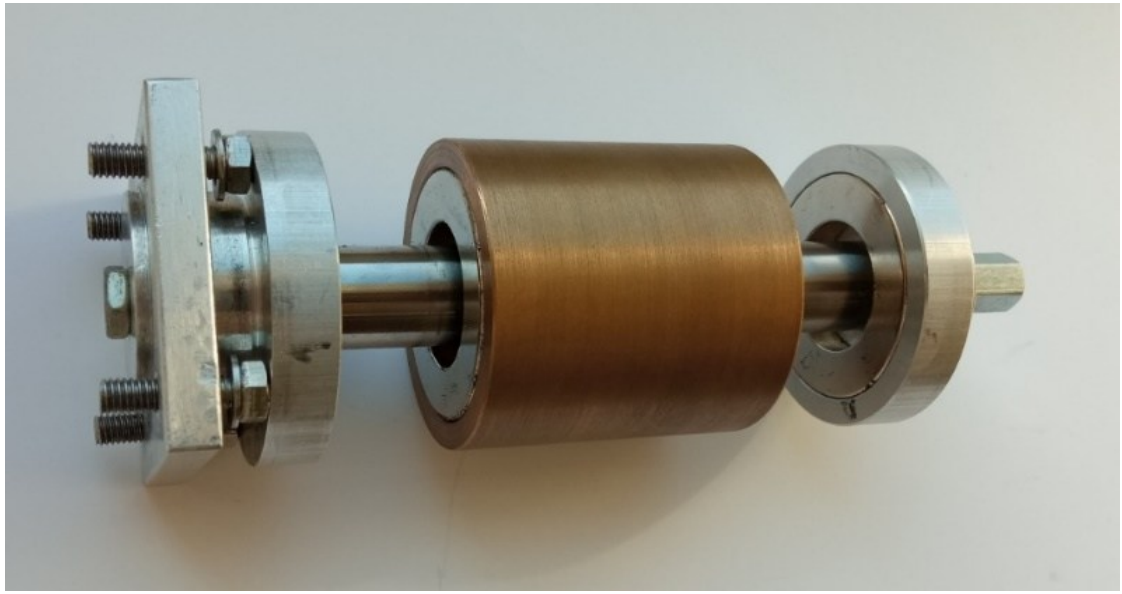


$$F_{m0} = A(x + 2b)^{-2}$$

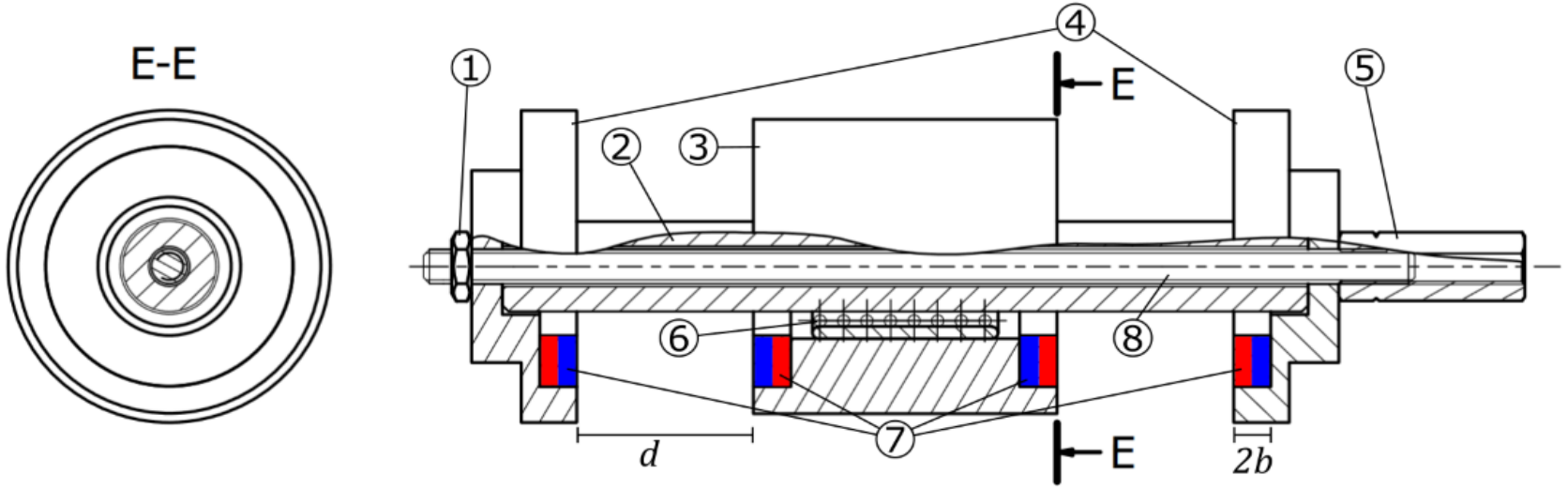
$$A = F_0(2b)^2$$

Sprężyna magnetyczna



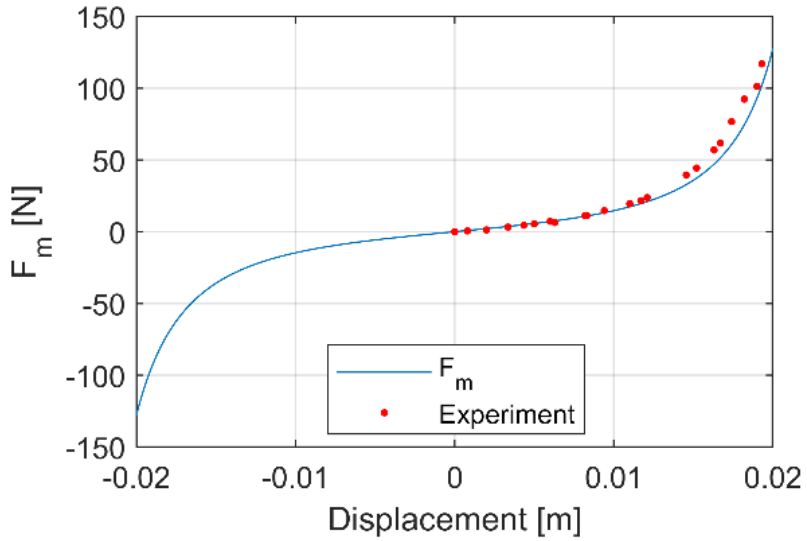


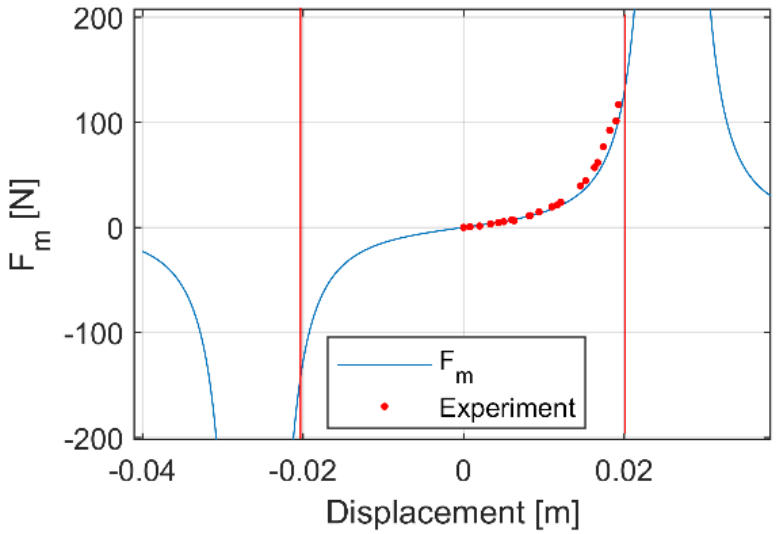
Sprężyna magnetyczna



$$F_m = A \cdot \left((-x + d + 2b)^{-2} - (x + d + 2b)^{-2}\right)$$

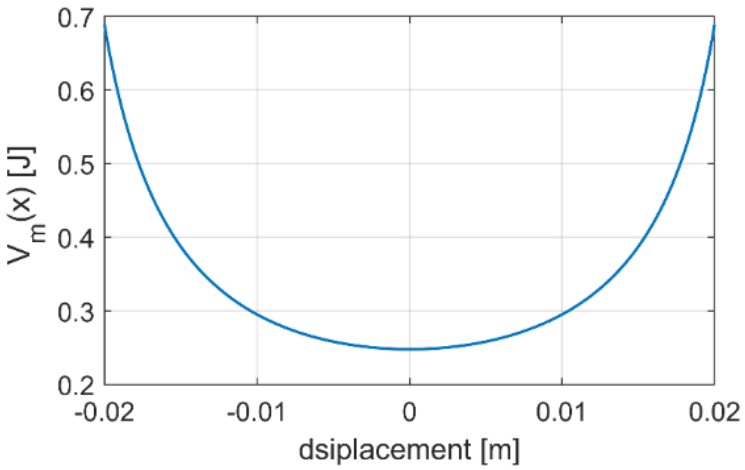
Sprężyna magnetyczna



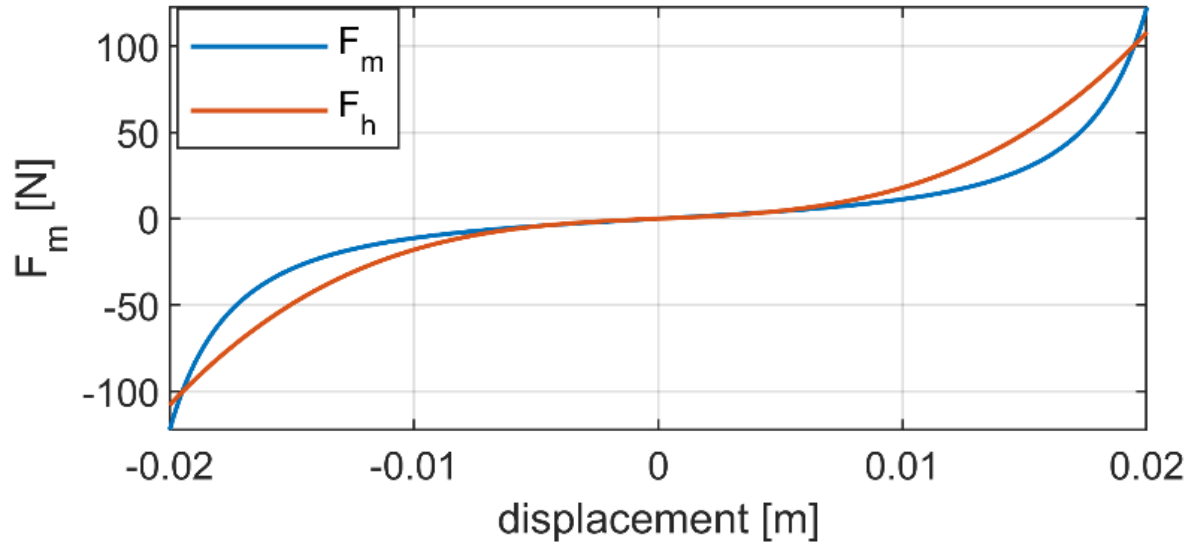


$$F_m = A \cdot \left((-x + d + 2b)^{-2} - (x + d + 2b)^{-2}\right)$$

$$V_m = \int F_m(x)dx = \frac{2A(2b + d)}{(4b^2 + 4bd + d^2 - x^2)}$$



Nieliniowa sztywność



$$F_h(x) = kx(1 + \epsilon x^2)$$

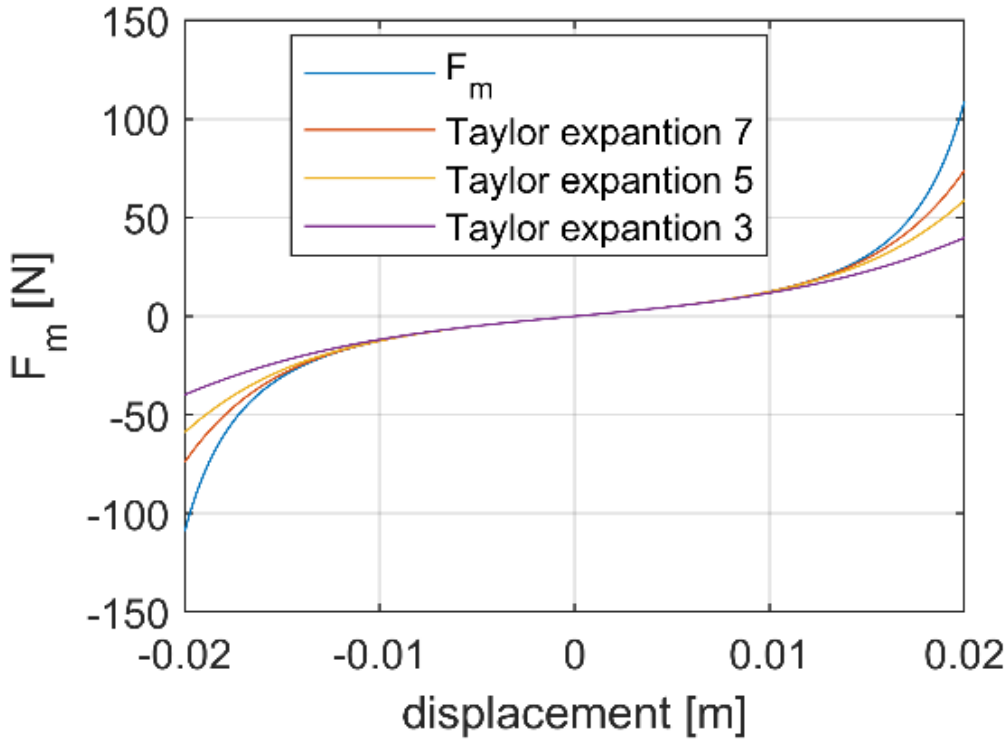
$$F_m = A \cdot \left((-x + d + 2b)^{-2} - (x + d + 2b)^{-2}\right)$$

Szereg Taylora

$$F_{m3} = A_1 x + A_3 x^3$$

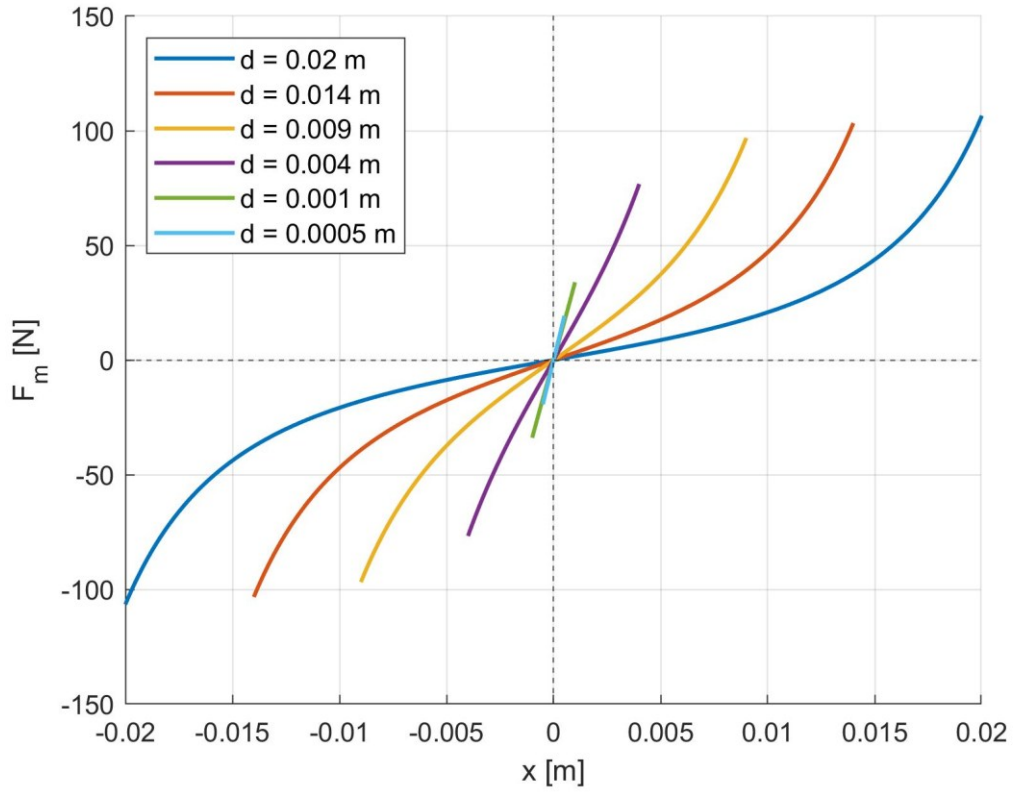
$$F_{m5} = F_{m3} + A_5 x^5$$

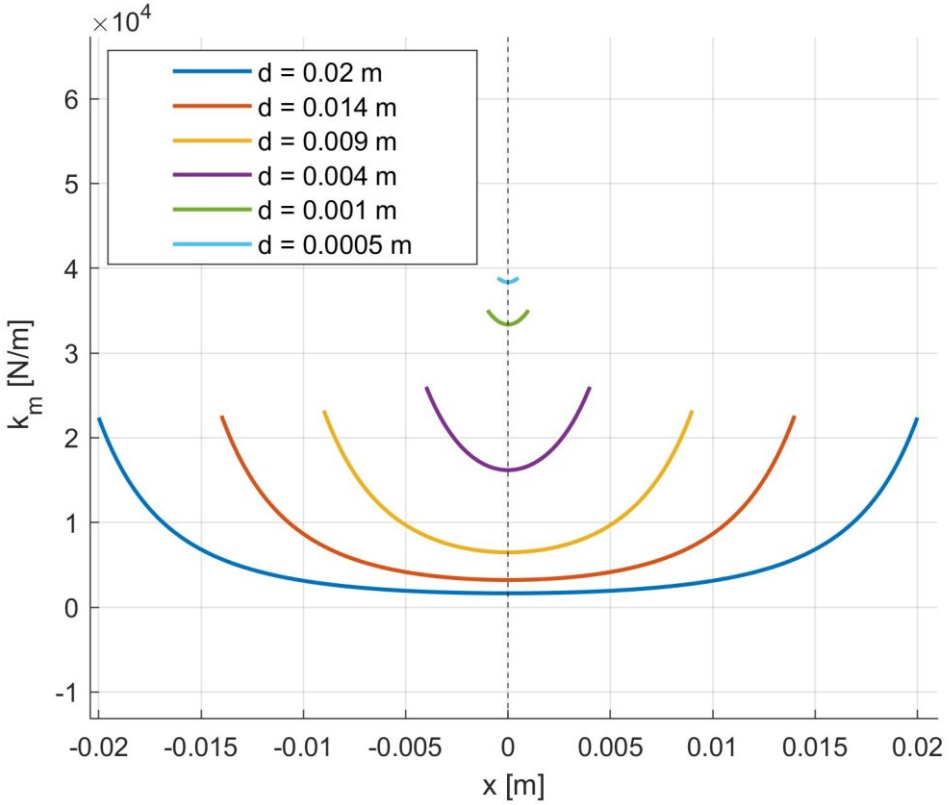
$$F_{m7} = F_{m5} + A_7 x^7$$



	$A_1 \left[\frac{N}{m}\right]$	$A_3 \left[\frac{N}{m^3}\right]$	$A_5 \left[\frac{N}{m^5}\right]$	$A_7 \left[\frac{N}{m^7}\right]$
F_{m3}	911.0687	$2.6955 \cdot 10^6$	0	0
F_{m5}	911.0687	$2.6955 \cdot 10^6$	$5.9811 \cdot 10^9$	0
F_{m7}	911.0687	$2.6955 \cdot 10^6$	$5.9811 \cdot 10^9$	$1.1797 \cdot 10^{13}$

Wpływ parametrów

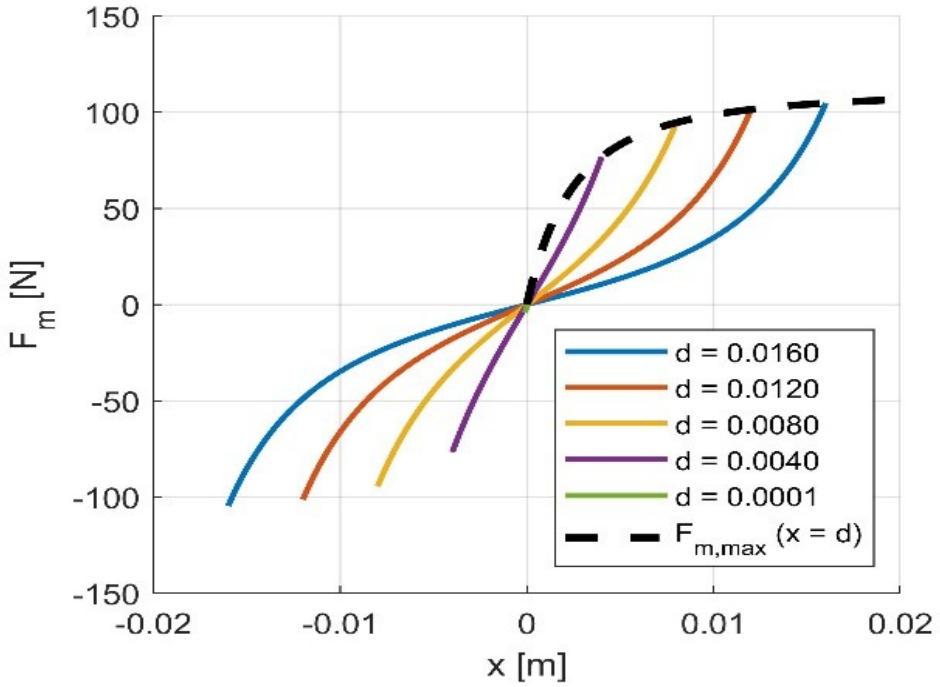


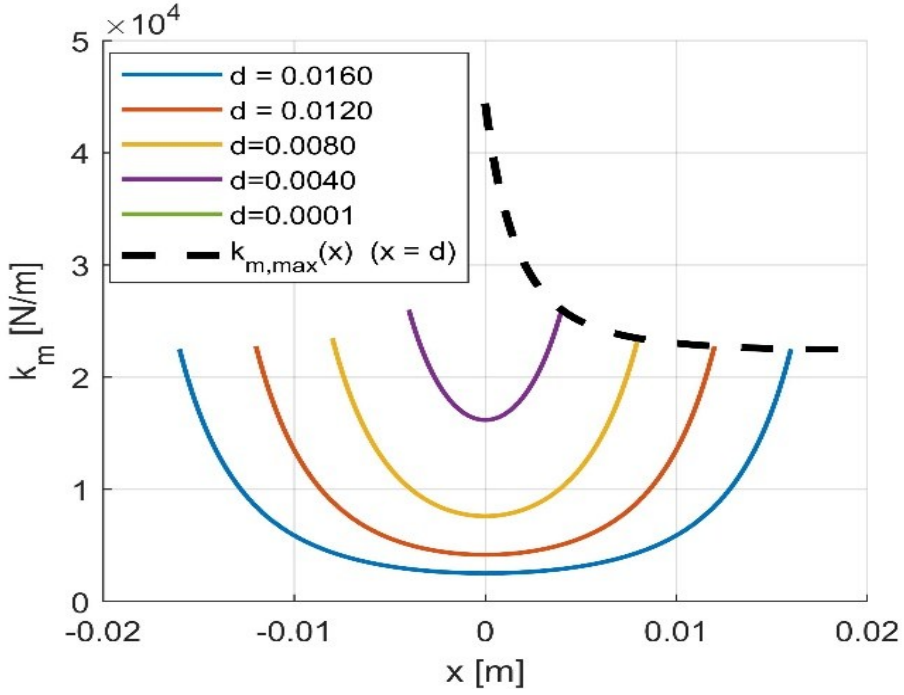


Wpływ parametrów

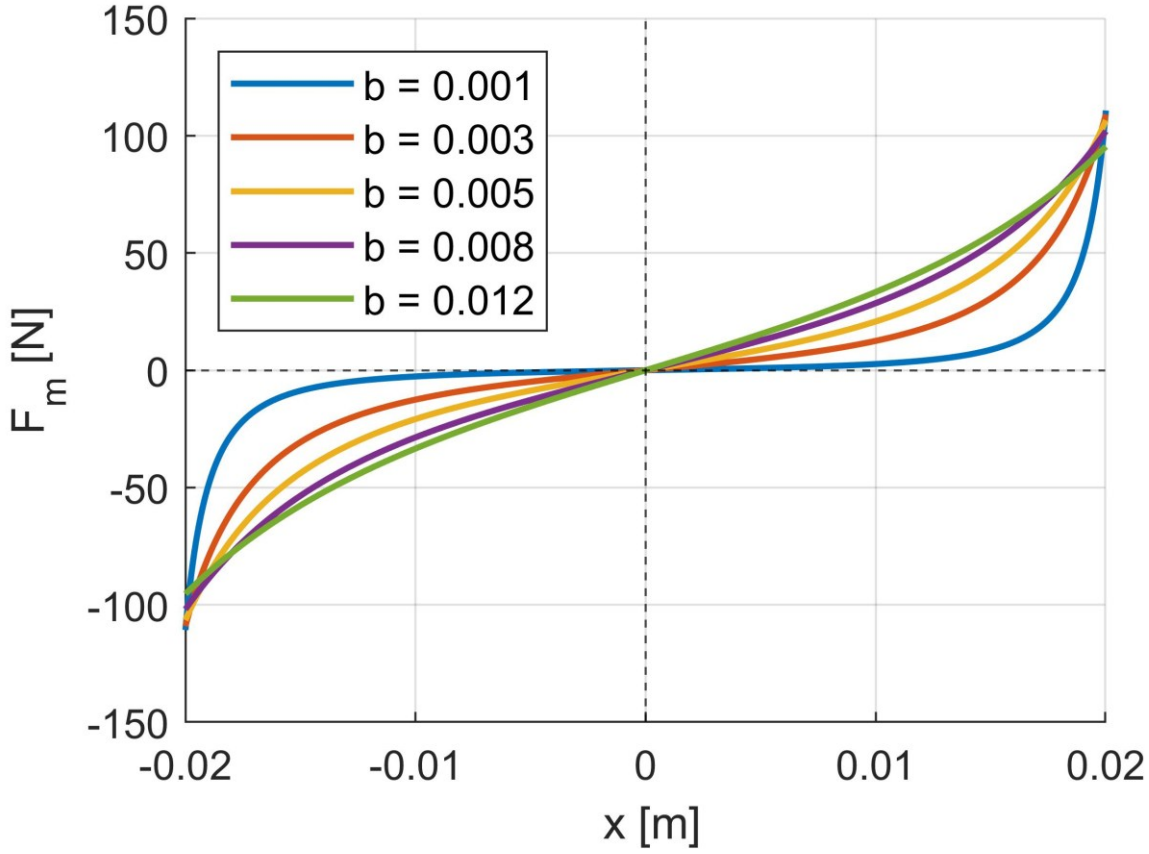
$$F_{m,Max}(d) = A\left((2b)^{-2} - (2(d+b))^{-2}\right)$$

$$k_{m,Max}(d) = 2A\gamma\left[(2b)^{-3} + \left(2(d+b)\right)^{-3}\right]$$





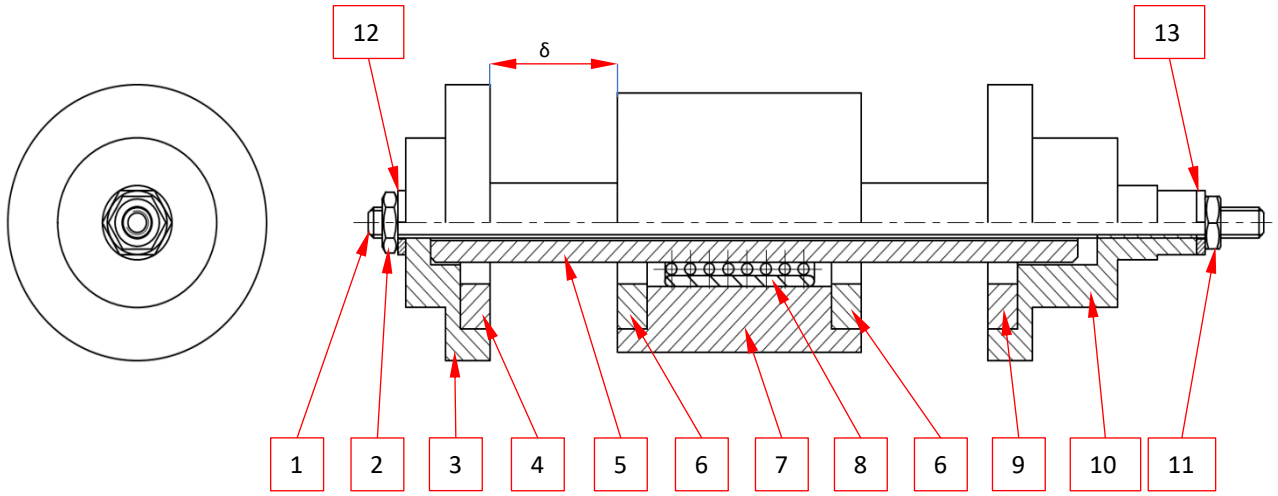
Wpływ parametrów



$$F_m = A \cdot \left((-x + d + 2b)^{-2} - (x + d + 2b)^{-2}\right)$$

$$A = F_0(2b)^2$$

Sprężyna o zmiennym *d*



URZĄD PATENTOWY
RZECZYPOSPOLITEJ POLSKIEJ

DOKUMENT PATENTOWY

Na podstawie przepisów ustawy z dnia 30 czerwca 2000 r. Prawo własności przemysłowej (Dz. U. z 2023 r. poz. 1170) został udzielony na rzecz:

POLITECHNIKA ŁÓDZKA, Łódź, Polska

PATENT

NR **248010**

NA WYNALAZEK PT.

Dynamiczny tłumik drgań z nastawianą sztywnością magnetyczną

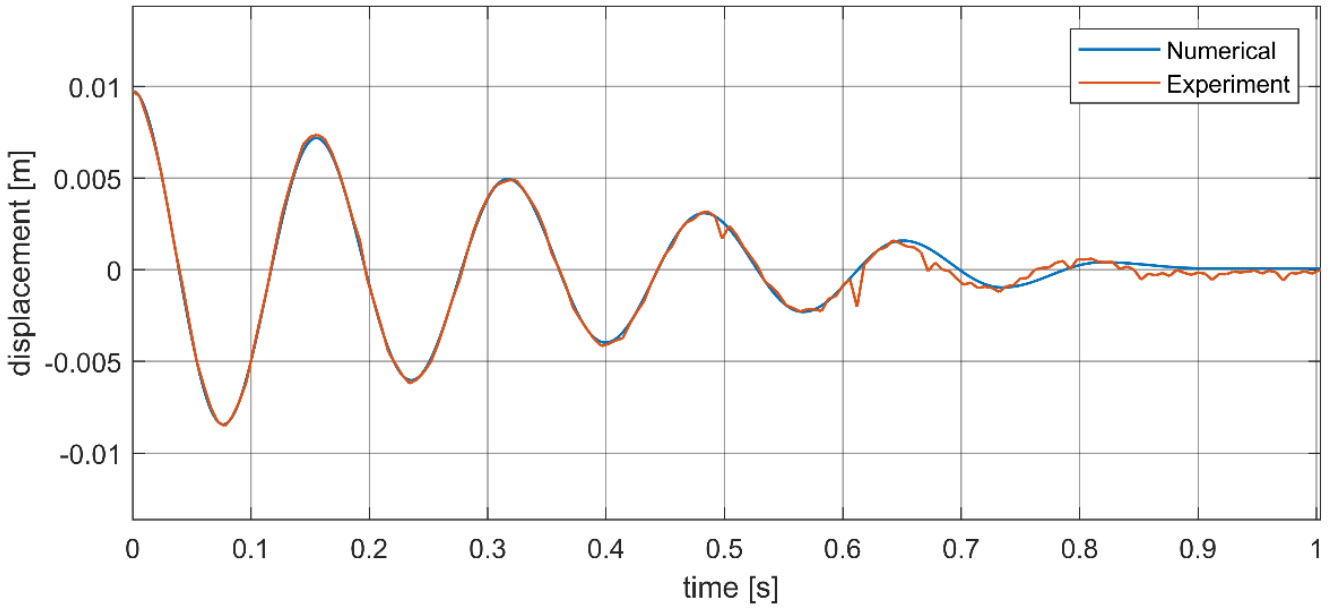
przedstawiony w opisie patentowym
włączonym do niniejszego dokumentu

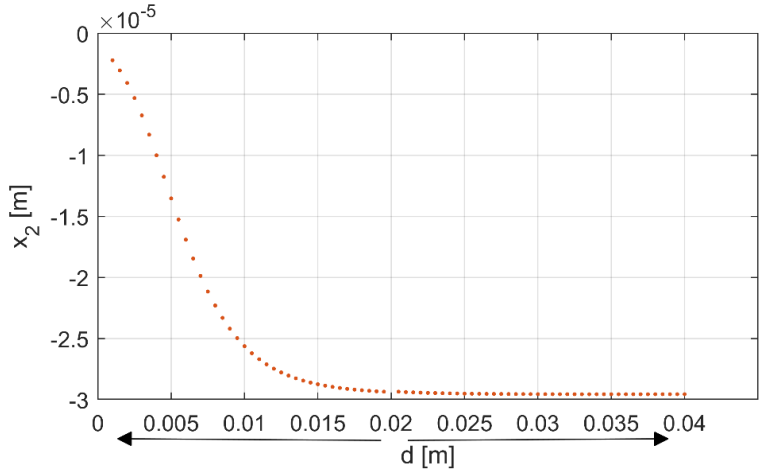
Patent trwa od dnia: **2022-10-12**

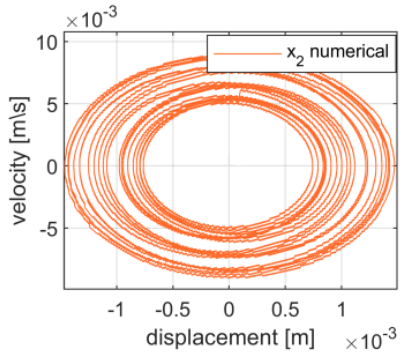
Warszawa, dnia 2025-09-24

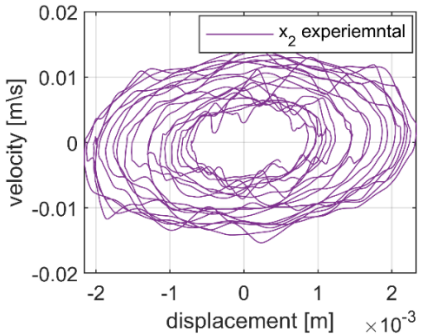
Z upoważnienia Prezesa
Urzędu Patentowego
Starszy Specjalista
mgr Monika Russek

Dynamiczne badania









$$m_2\ddot{x}_2 = A \cdot \left((-(x_2 - d) + 2b)^{-2} - \left((x_2 + d) + 2b\right)^{-2}\right) - c_{c4}\dot{x}_2 - c_{c5}\mathrm{sgn}(\dot{x}_2)$$

Dziękuję za uwagę