3LP5-12

Analysis of the motion of a body in the linear HTS suspension along a curvilinear trajectory

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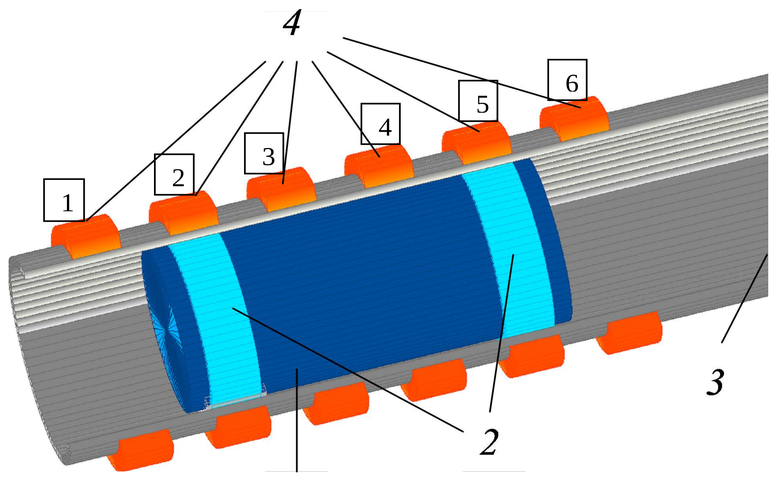
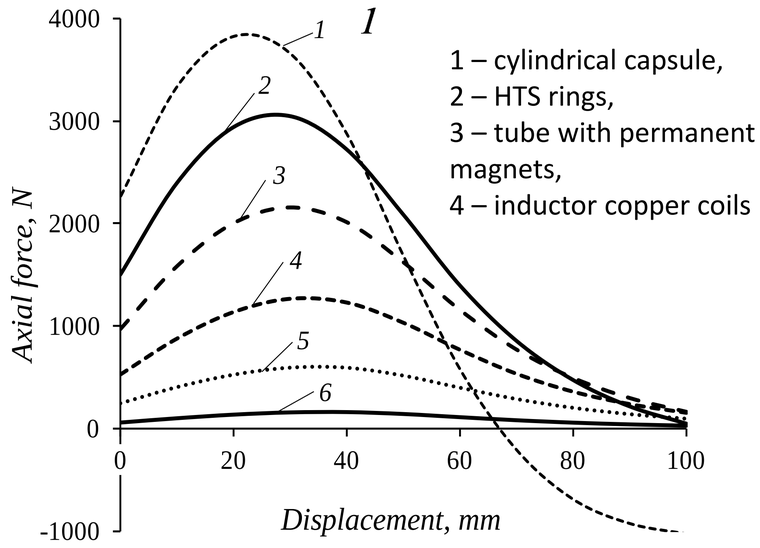
Acceleration System



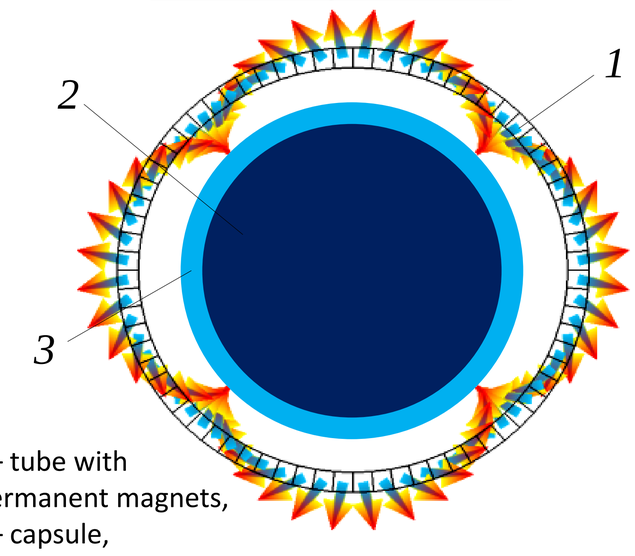


1 – cylindrical capsule,
2 – HTS rings,
3 – tube with permanent magnets,
4 – inductor copper coils

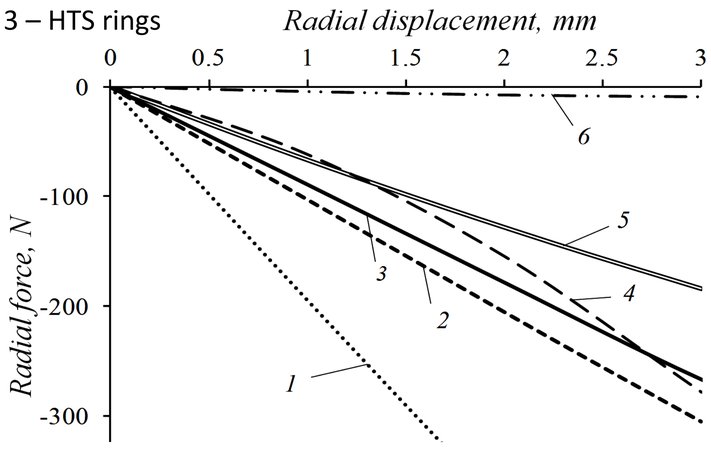
Dependences of the acceleration force acting on one HTS ring on the displacement of the capsule: *1* – m.m.f=75 кА; *2* - m.m.f=50 кА; *3* - m.m.f=40 кА; *4* - m.m.f=30кА; *5*- m.m.f= 20кА; *6* - m.m.f= 10 кА

Acceleration force is effective on the region of displacement not more than 100 mm.

HTS suspension

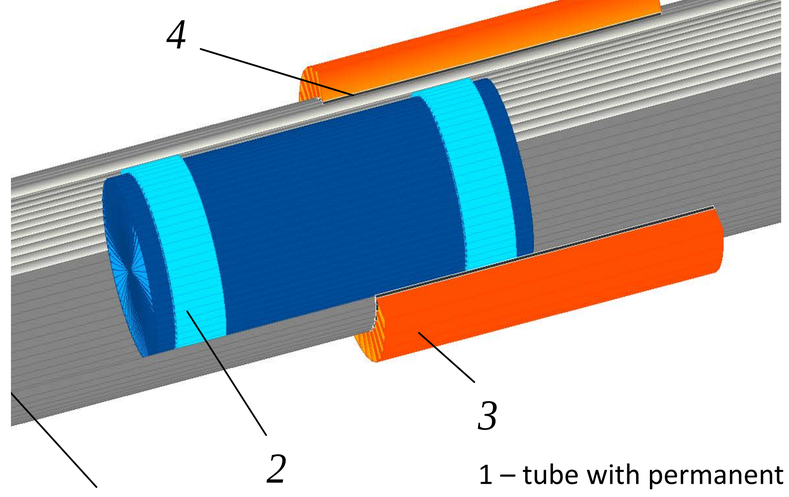


1 – tube with permanent magnets,
2 – capsule,
3 – HTS rings

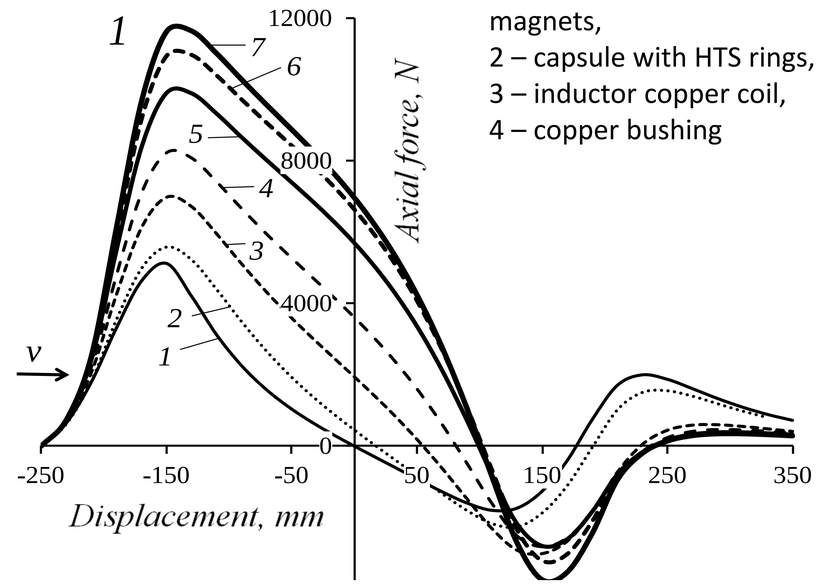


Dependences of radial force of thr HTS suspension: *1-4,6* - Halbach magnetic structure; *5* - salient-pole magnetic structure; *1-3,5,6* - FC mode; *4*- ZFC mode; *1-5* - radial anisotropy; *6* - axial anisotropy; *1* - coils 1,2 with m.m.f.= 50 kA; *3* - after m.m.f.= 50 kA; *1* – capsule at the beginning; 2-6 – capsule far from the ends

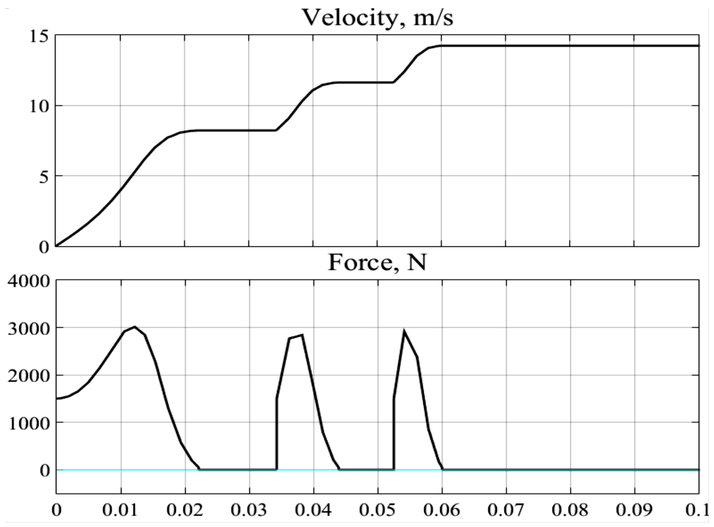
Deceleration System



1 – tube with permanent magnets,
2 – capsule with HTS rings,
3 – inductor copper coil,
4 – copper bushing

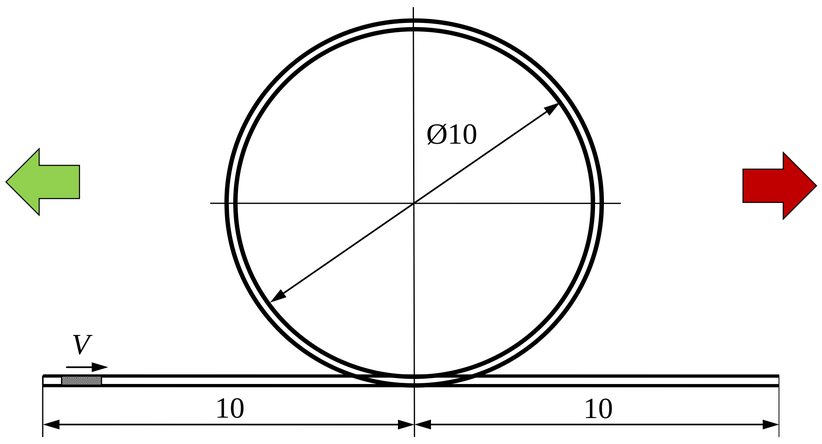


Dependences of the deceleration force acting on one HTS ring on the distance between the HTS ring and the inductor coil: *1* - *v*=0,1 m/s; *2* - *v*=0,5 m/s; *3* - *v*=2,0 m/s; *4* - *v*=4,0 m/s; *5*- *v*=8,0 m/s; *6* - *v*=12,0 m/s; *6* - *v*=16,0 m/s

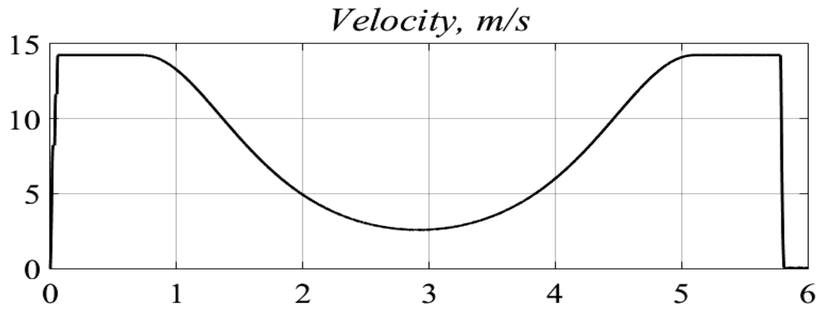


Time dependences during acceleration.
The process has three steps when the coils are activated in pairs. M.m.f. of the each coil 50 kA. The steady speed 14.24 m/s.

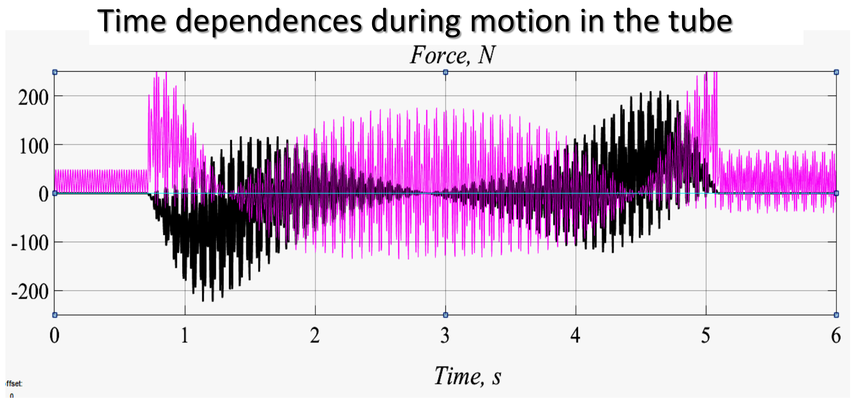
Motion of a body



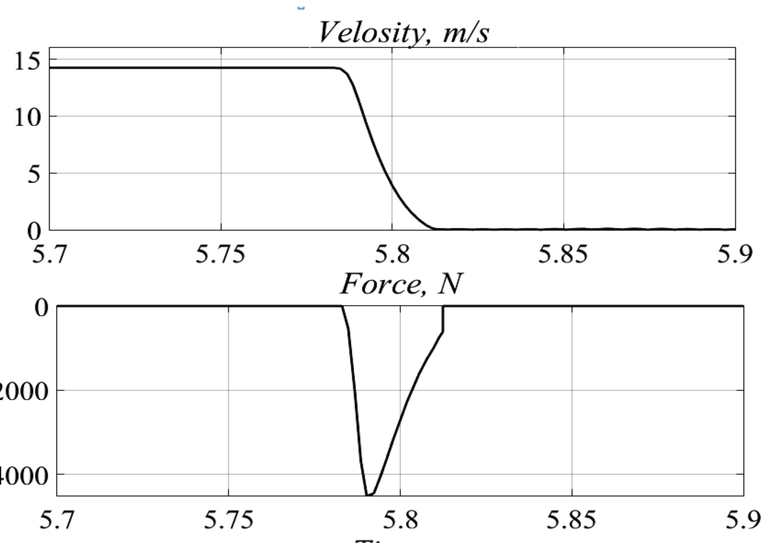
The tube has two horizontal rectilinear regions and one vertical circular region between them. Dimensions are shown in meters



Time dependences during motion in the tube



Time dependences of coordinate components of the forces acting on one HTS ring on different regions of the tube

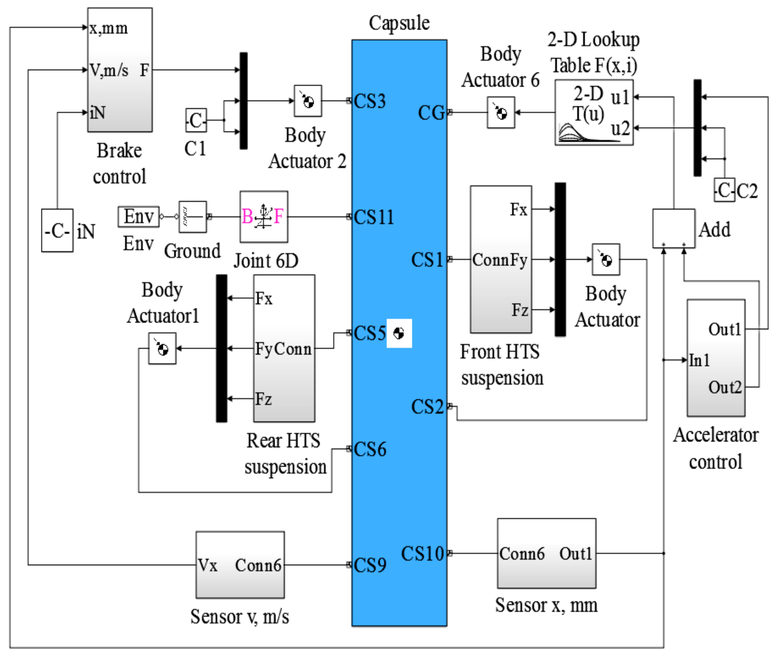


Time dependences during deceleration.
M.m.f. of the inductor coil 200 kA.. Time of the decelerating process 30 ms.

Parameters of construction

Capsule	
diameter	176 mm
length	370 mm
mass with HTS rings	5 kg
moment of inertia along the longitudinal axis	0.0227 kg·m²
moment of inertia along the transverse axis	0.0706 kg·m²
HTS rings	
inner diameter	176 mm
outer diameter	190 mm
material	YBaCuO
number of rings	2
the distance between the centers of rings	300 mm
Tube	
inner diameter with permanent magnets	202 mm
outer diameter	222 mm
Acceleration system	
inner diameter of inductor coil	222 mm
outer diameter of inductor coil	242 mm
length of inductor coil	50 mm
number of inductor coils	6
the distance between the centers of coils	100 mm
Bushing of deceleration system	
inner diameter	214 mm
outer diameter	222 mm
length	350 mm
material	Cu
Inductor coil of deceleration system	
inner diameter	222 mm
outer diameter	280 mm
length	350 mm

Dynamic model



Conclusion

Considered constructions of the magnetic suspension, acceleration and deceleration systems have high specific force characteristics and can be recommended for practical implementation. Composed dynamic model of the motion inside the tube has necessary versatility for application in the design of such devices.

This work was supported by the Ministry of Education and Science of the Russian Federation. Project number: 8.9603.2017 / 8.9. Supported authors are E. Kurbatova, P. Dergachev.