RAPIDITY DRIVE SYSTEMS

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Application of drive systems in aircraft and drones

- At the moment, approximately three competition exist in the direction of jet drones and approximately couple competition exist in the direction of special purpose underwater drones. All these drones are prototypes.
- This direction is now developing and in the future jet drones will replace combat jets.
- Therefore, it is necessary to improve the dynamics of jet drones. The improving of jet drone dynamics requires improving drive and fuel systems of jet drone.

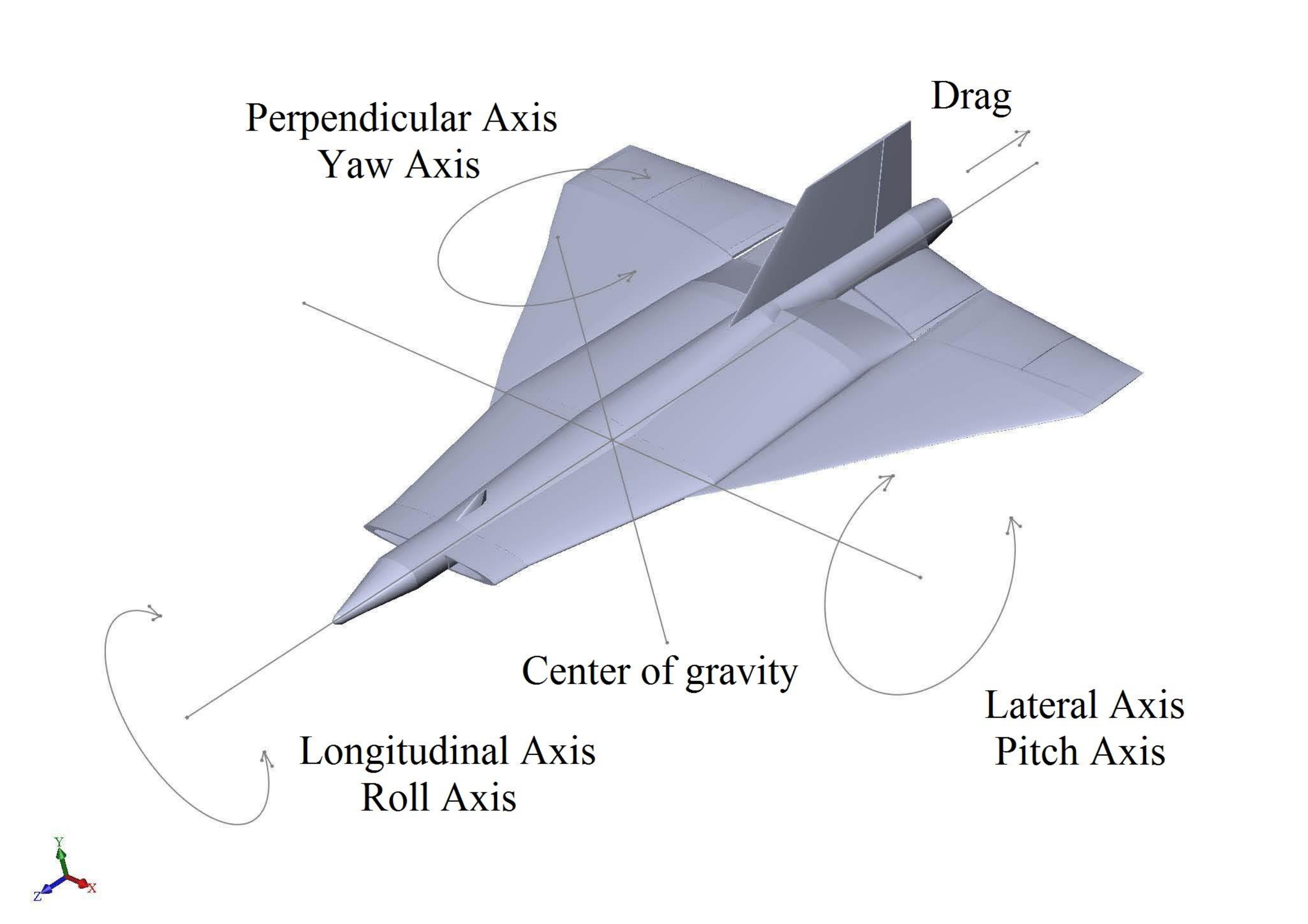
General Atomics MQ-20 Avenger

Sierra Technical Services 5GAT Drone

Baykar Bayraktar Kızılelma

Application of drive systems in aircraft and drones

- For stability and movement around the axis of aircraft, the control surfaces are used.
- The control surfaces are set in motion by a drive systems.
- Primary Control Surfaces (aircraft or drone can be controlled in three different axis):



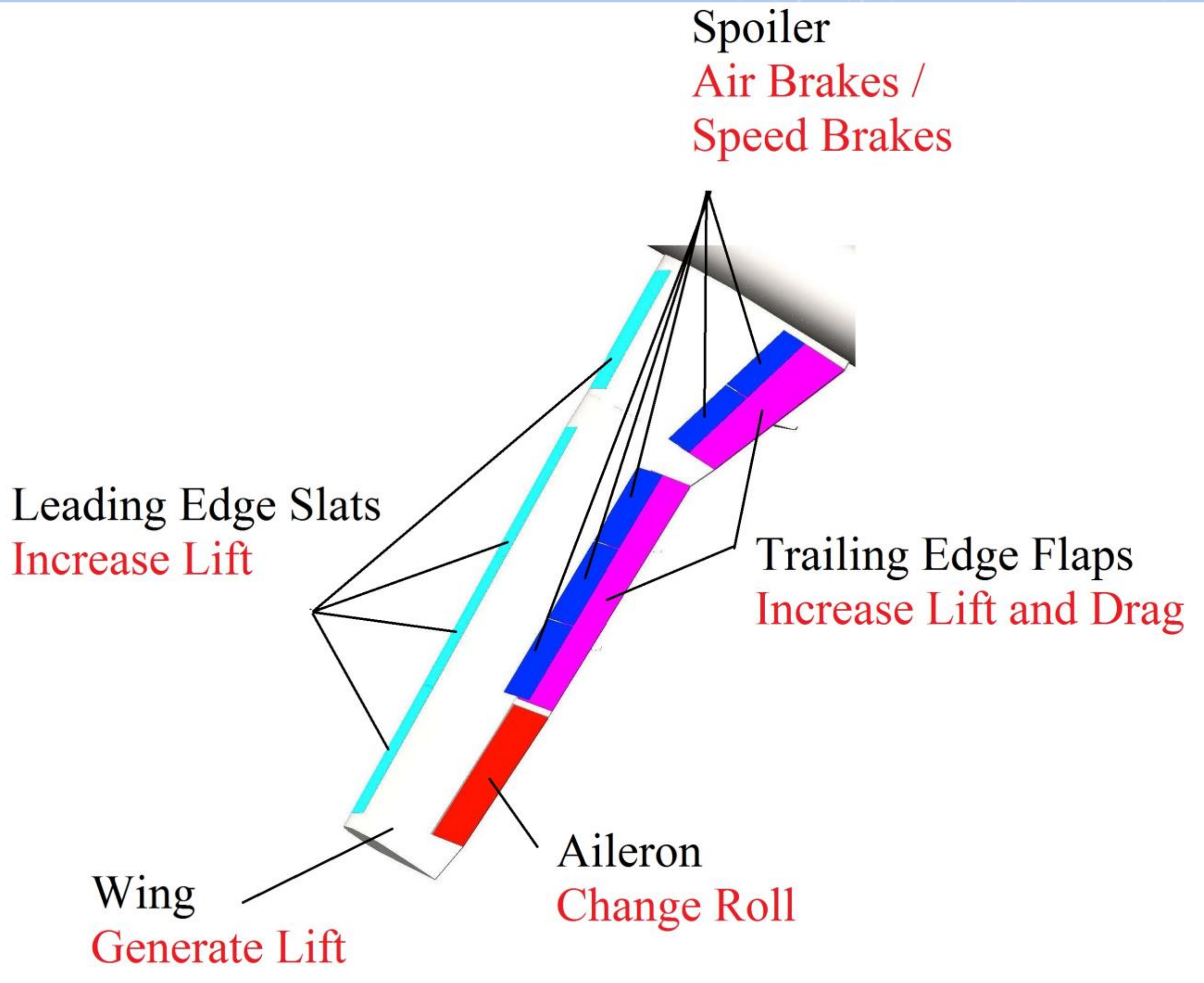
- AILERONS – ROLL AXIS (LONGITUDINAL AXIS);
- ELEVATORS – PITCH AXIS (LATERAL AXIS);
- RUDDER – YAW AXIS (PERPENDICULAR AXIS).

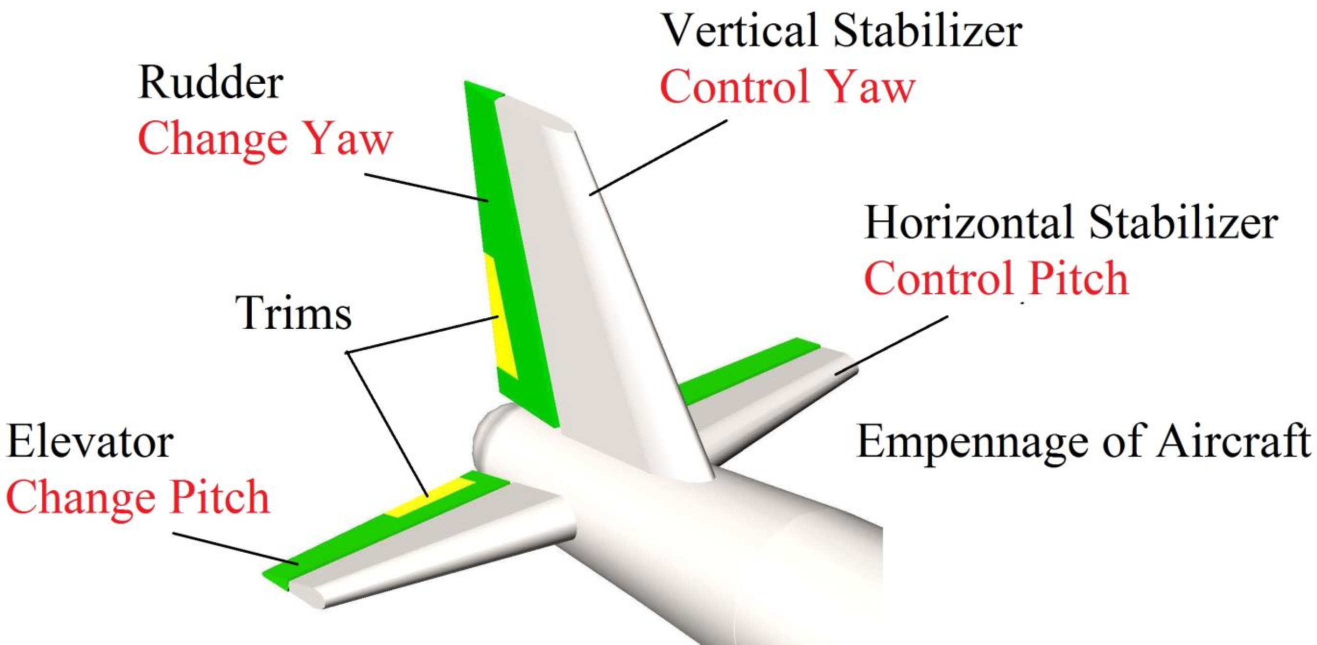
Application of drive systems in aircraft and drones

Secondary Control Surfaces (Flaps, Slats, Trims and Spoilers):

Flaps are a type of high-lift device used to increase the lift of an aircraft wing at a given airspeed. Flaps are usually mounted on the wing trailing edges of a fixed-wing aircraft.

Slats are aerodynamic surfaces on the leading edge of the wings of fixed-wing aircraft which, when deployed, allow the wing to operate at a higher angle of attack.





Spoilers are plates on the top surface of a wing that can be extended upward into the airflow to spoil it, to reduce airspeed.

Trims are small surfaces connected to the trailing edge of a larger control surface on an aircraft.

Patented vortex electromagnetic field technology in drive and fuel systems

Hydraulic and magnetorheological drive systems have found wide application in the plane and rocket industry but magnetorheological drive systems significantly exceed the existing hydraulic analogue in the accuracy and rapidity. The use of magnetorheological drive systems makes the control of actuated mechanical elements easier and magnetorheological drive systems can be applied in the upper control flow paths of the multistage hydraulic amplifiers. Magnetorheological drive systems use magnetorheological fluid as the working fluid.

It is advisable to develop not only the magnetorheological systems, but also to create the hybrid constructions of hydraulic systems (drive and fuel systems) with magnetorheological control flow paths or ferrofluid control element.

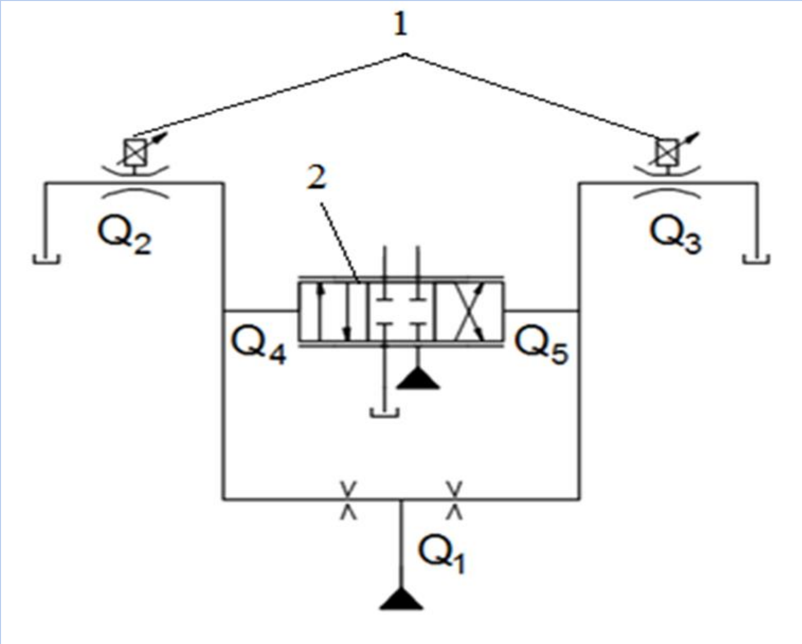
We have patents of original vortex electromagnetic field technology in the special purpose devices.

Patents:

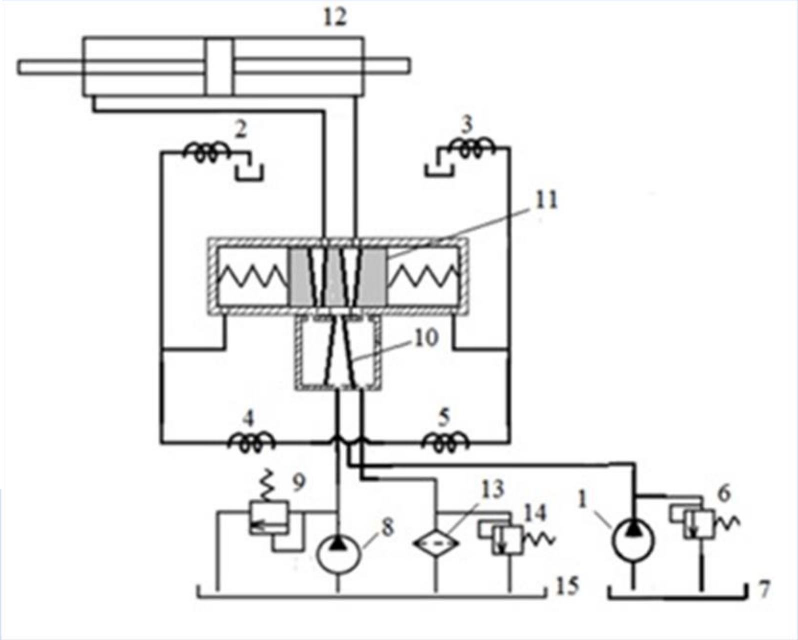
WO 2016/028180
WO 2016/028181
WO 2016/028182
RU 192674 U1
RU 2624082 C2

RU 2634163 C2
RU 2634166 C2
RU 185538 U1
RU 175044 U1
RU 2639906 C1

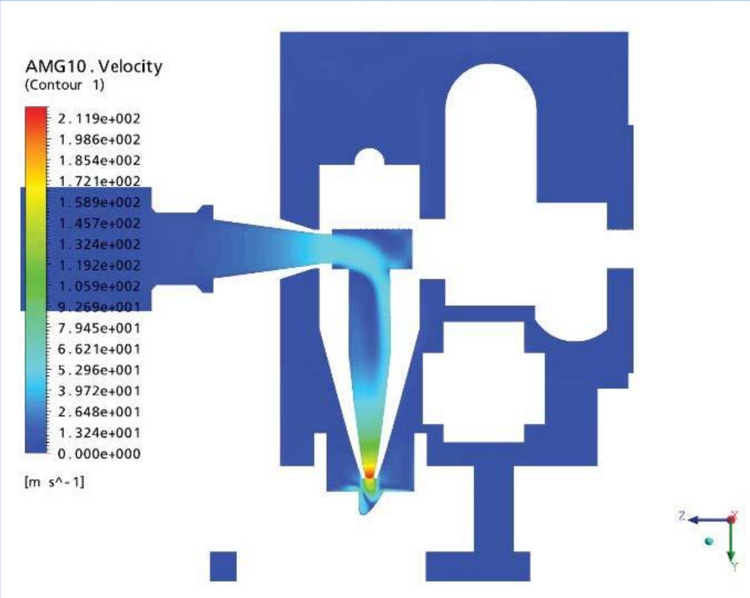
Patented vortex electromagnetic field technology in drive and fuel systems

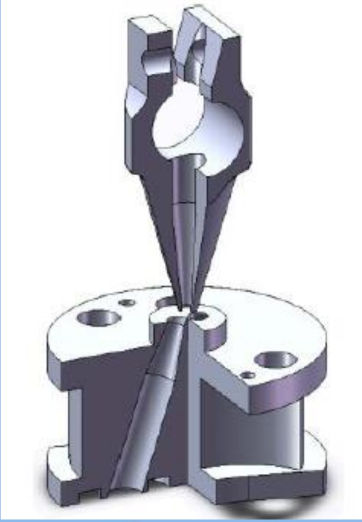


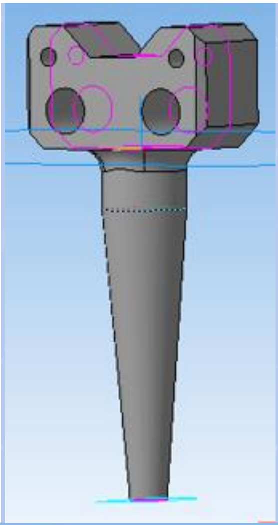
Multistage hydraulic amplifiers
(WO 2016/028180,
WO 2016/028181,
WO 2016/028182)
1 – MHD control device,
2 – hydraulic distributor valve.

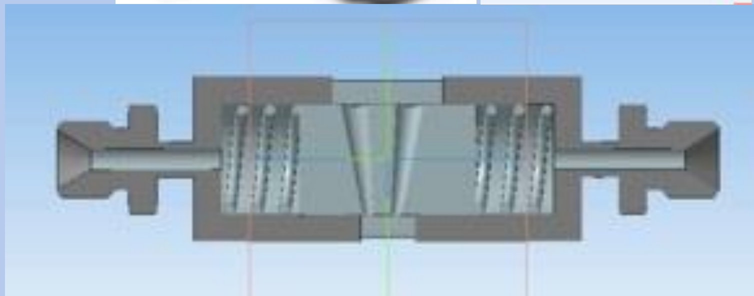


Hybrid hydraulic drive system
(WO 2016/028180, WO 2016/028181, WO 2016/028182)
1 – MHD pump, 2,3,4,5 – MHD control device,
6 – safety valve, 7 – tank, 8 – hydraulic pump,
9 – safety valve, 10 – jet supply tube, 11 – deflector,
12 – hydraulic cylinder, 13 – filter,
14 – safety valve, 15 – tank.









Magnetorheological fluid as the working fluid of magnetorheological drive systems

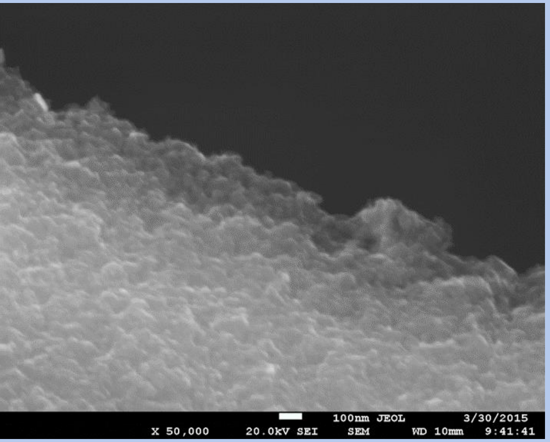
Magnetorheological fluids are smart materials characterized by fast, tuneable and reversible changes of their rheological properties under application of magnetic fields.

Magnetorheological fluids are composed of micron-sized particles of magnetizable materials, dispersed in a liquid.

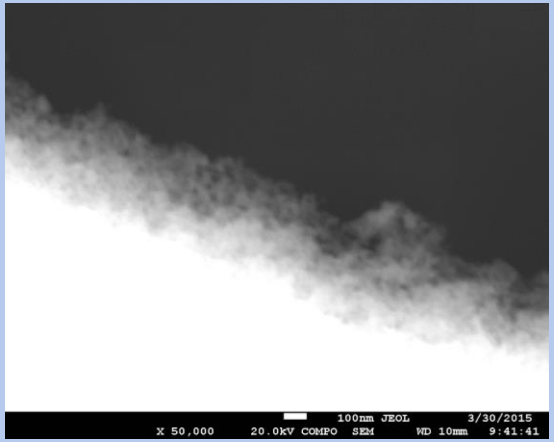
Application of magnetic fields results in the magnetization of the dispersed particles, which consequently experience attractive forces, this leads to the formation of particle structures that oppose the flow.

Quality of working fluid with Fe_3O_4 particles

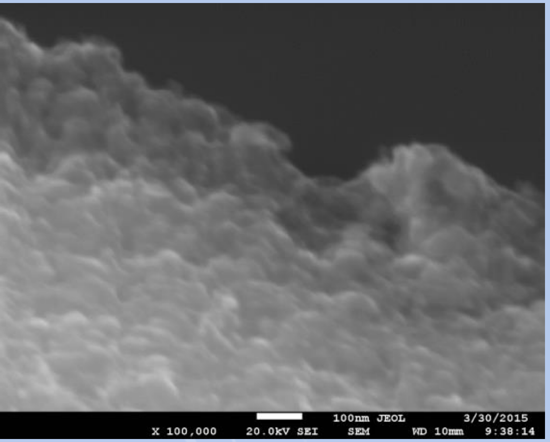
Spectrum	O %	Na %	Al %	Si %	Ca %	Cr %	Fe %	Co %	Total %
Spectrum 1	27.94	2.96	0.49	0.26	0.36	0.27	67.17	0.55	100.00



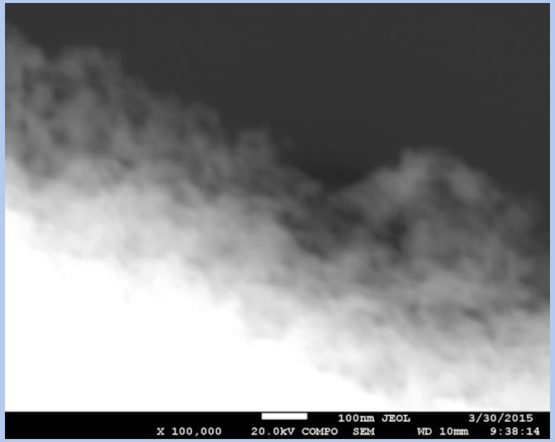
x 50.000; 20.0 kV SEI



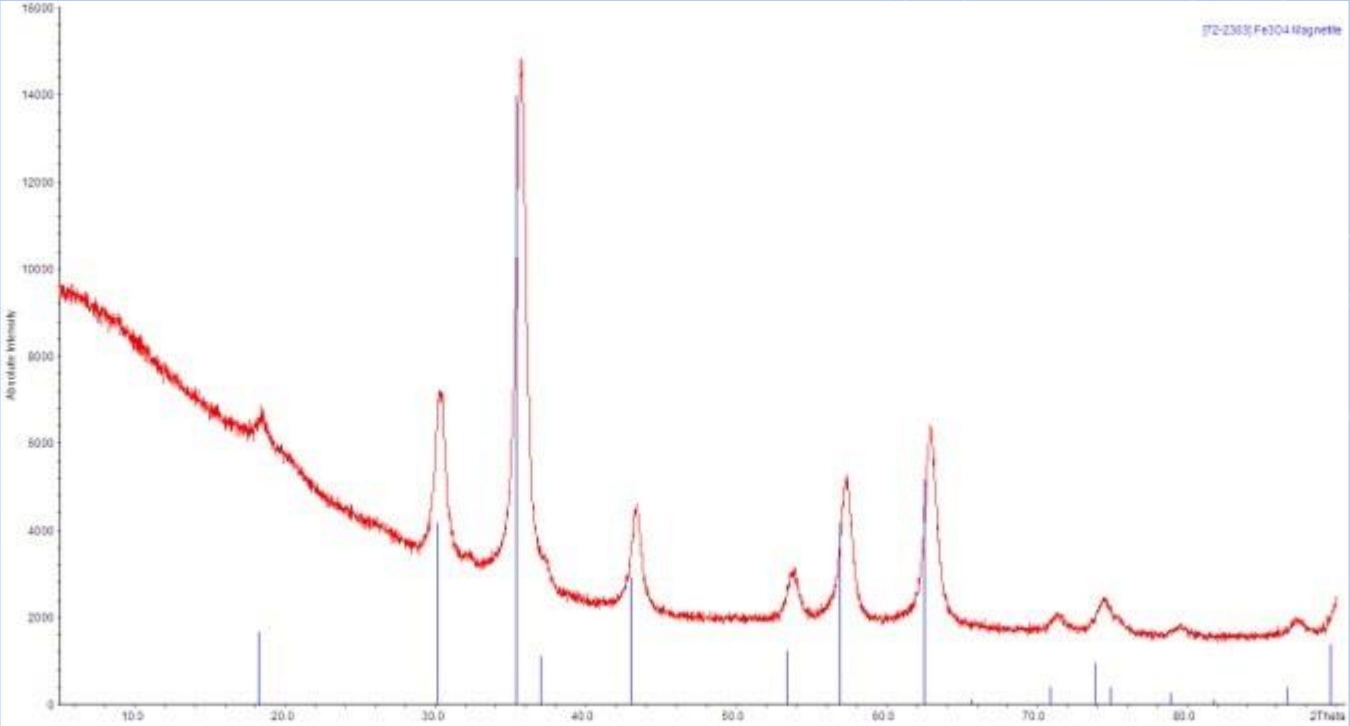
x 50.000; 20.0 kV COMPO



x 100.000; 20.0 kV SEI



x 100.000; 20.0 kV COMPO



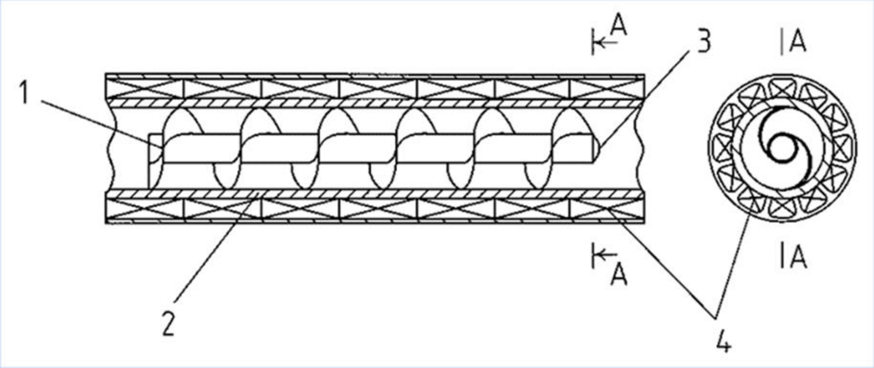
Spectrum of Fe_3O_4

Particle (Fe_3O_4) size according to scanning electron microscopy is 10 – 50 nm.

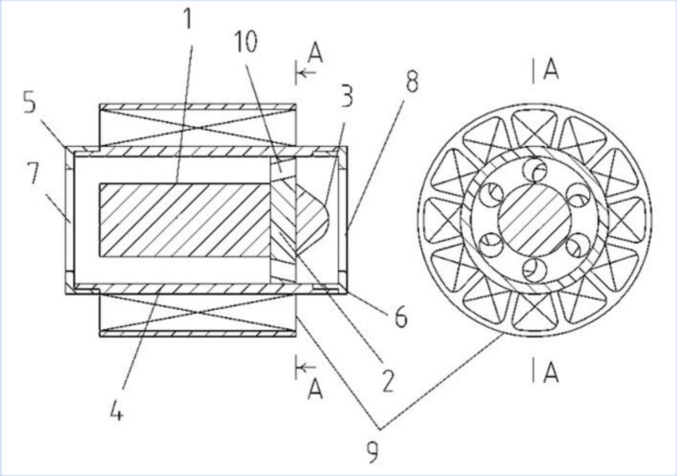
Vortex technology in magnetohydrodynamic and magnetorheological devices

- Linear magnetohydrodynamic (MHD) / magnetorheological (MR) devices are underpowered. It is obvious that the using of the spiral flow path allows achieving a significant increase of energy the MHD / MR devices at small dimensions of MHD / MR element.
- MHD / MR devices are applied to pump and control magnetorheological fluids, liquid metals, seawater and plasmas.
- We invented the original patented MHD pump (accelerator) construction and MR control device with helical electromagnetic control fields.
- The patented MHD pump can be used as a high efficient MHD generator (WO 2016/028180, WO 2016/028181, WO 2016/028182).

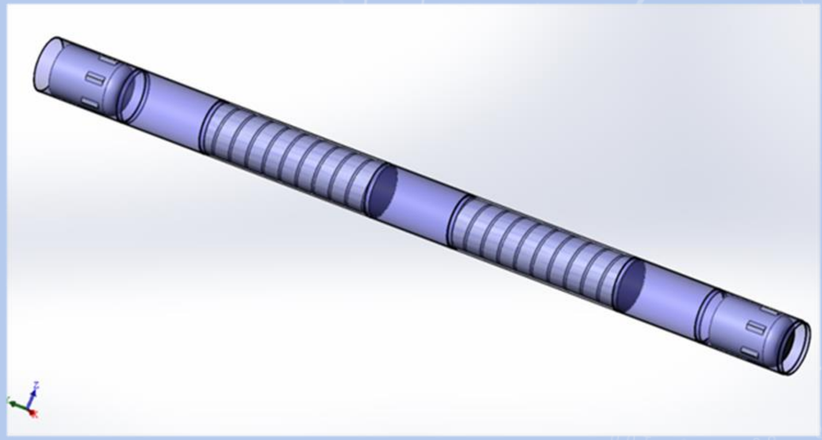
Vortex technology in magnetohydrodynamic (MHD) / magnetorheological (MR) devices



MHD pump / generator construction with helical electromagnetic control fields (WO 2016/028181)
1 – spiral flow path, 2 – housing, 3 – fairing,
4 – electromagnetic flow control block.

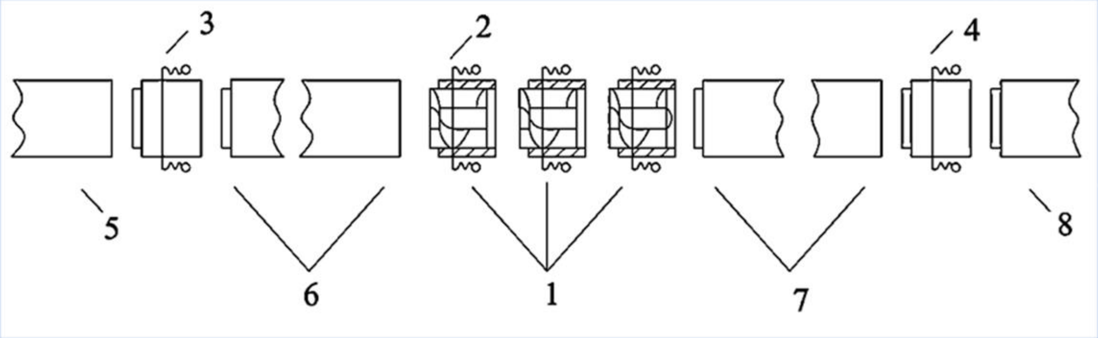


MHD / MR device with modular structures (WO 2016/028182)
1 – internal element, 2 – swirler, 3 – fairing,
4 – housing, 5,6 – covers, 7,8 – holes for pipes,
9 – electromagnetic flow control block,
10 – swirler's hole.



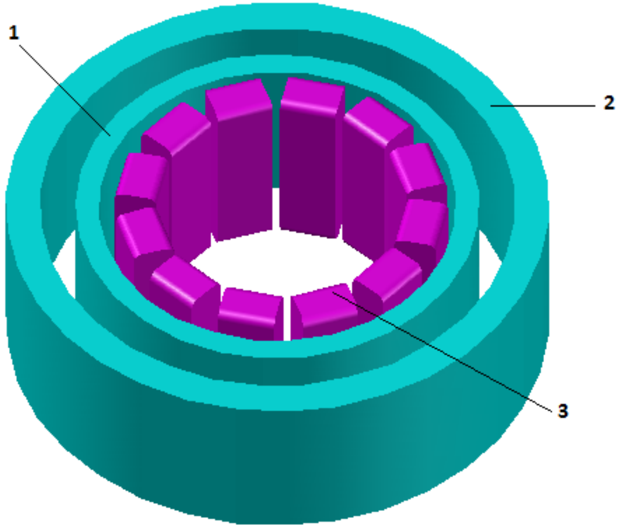
The spiral flow path of MHD / MR device with modular structures (WO 2016/028180)

The example of MHD / MR control device by vortex technology (WO 2016/028182)

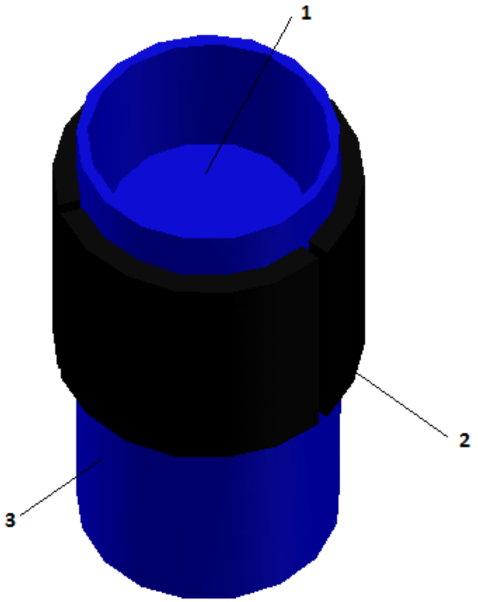


MHD / MR device with modular structures (WO 2016/028180)
1 – MHD block, 2 – module of MHD device,
3,4 – MHD / MR control device, 5,6,7,8 – flow path of MHD / MR device.

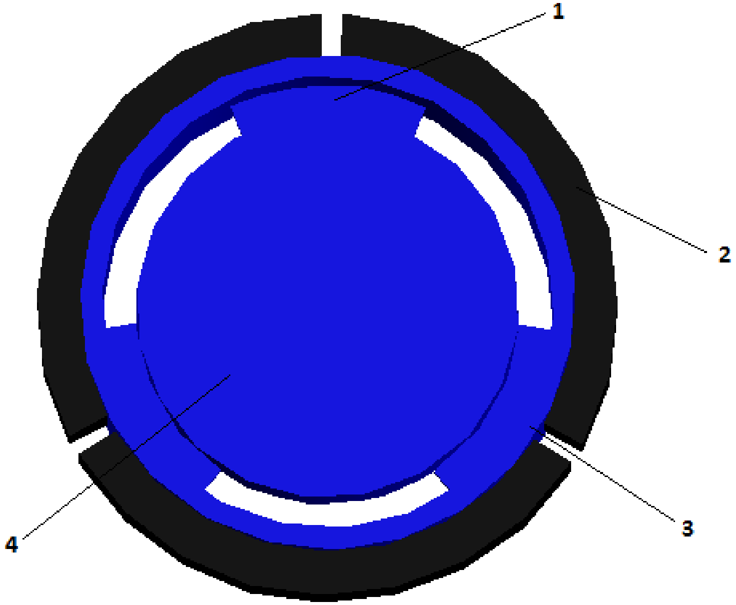
Modifications of vortex magnetohydrodynamic (MHD) / magnetorheological (MR) devices



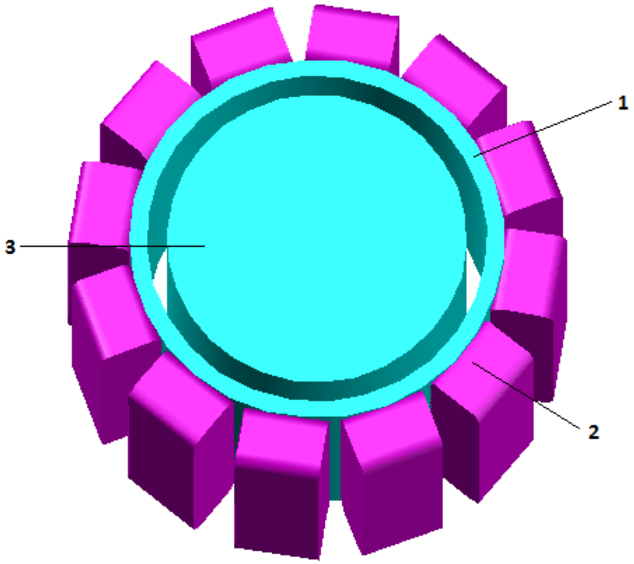
1 – internal element,
2 – housing,
3 – electromagnetic flow control block.



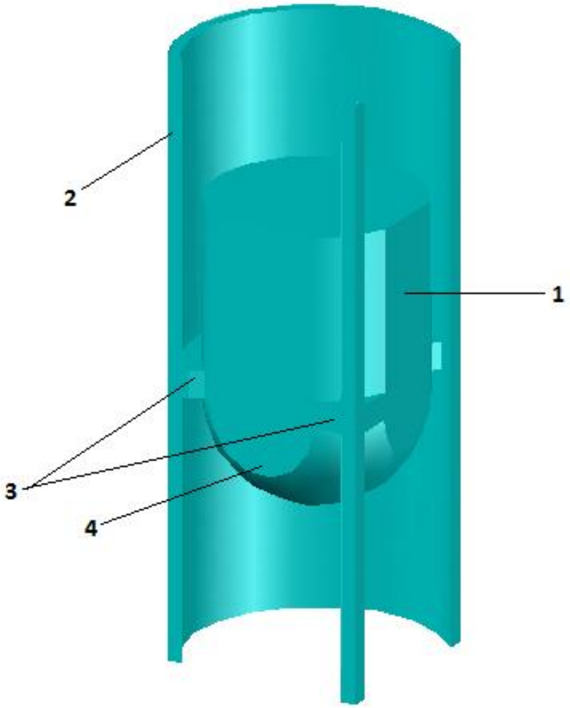
1 – internal element,
2 – electromagnetic flow control block,
3 – housing.



1 – flow straightener,
2 – electromagnetic flow control block,
3 – housing,
4 – internal element.



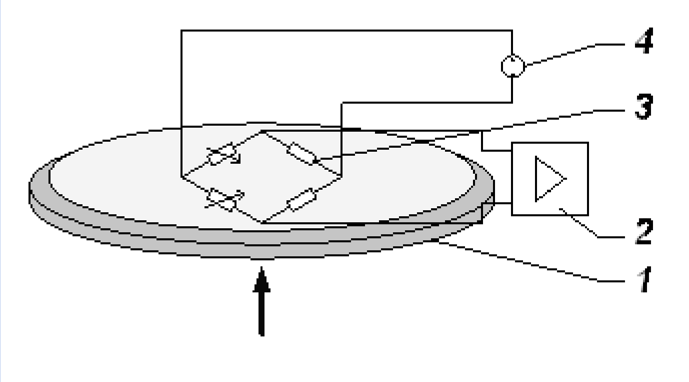
1 – housing,
2 – electromagnetic flow control block,
3 – internal element.



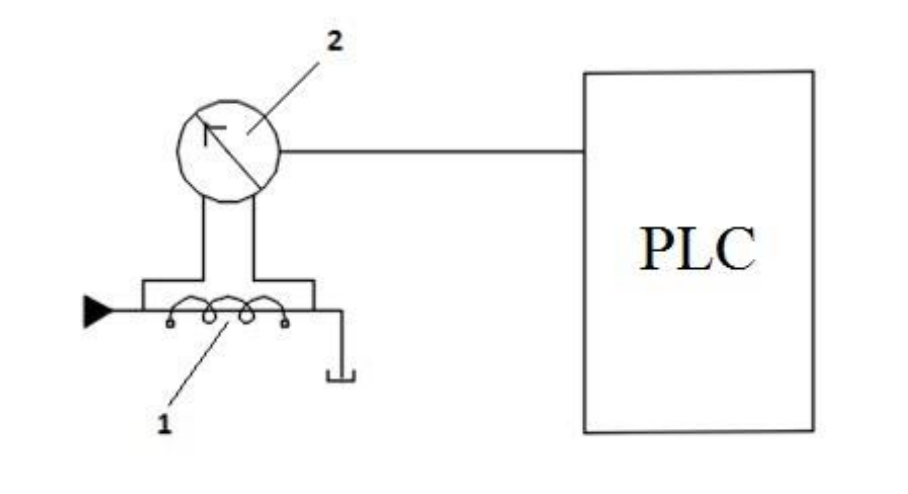
hydraulic parts:

1 – internal element,
2 – housing,
3 – flow straightener,
4 – fairing.

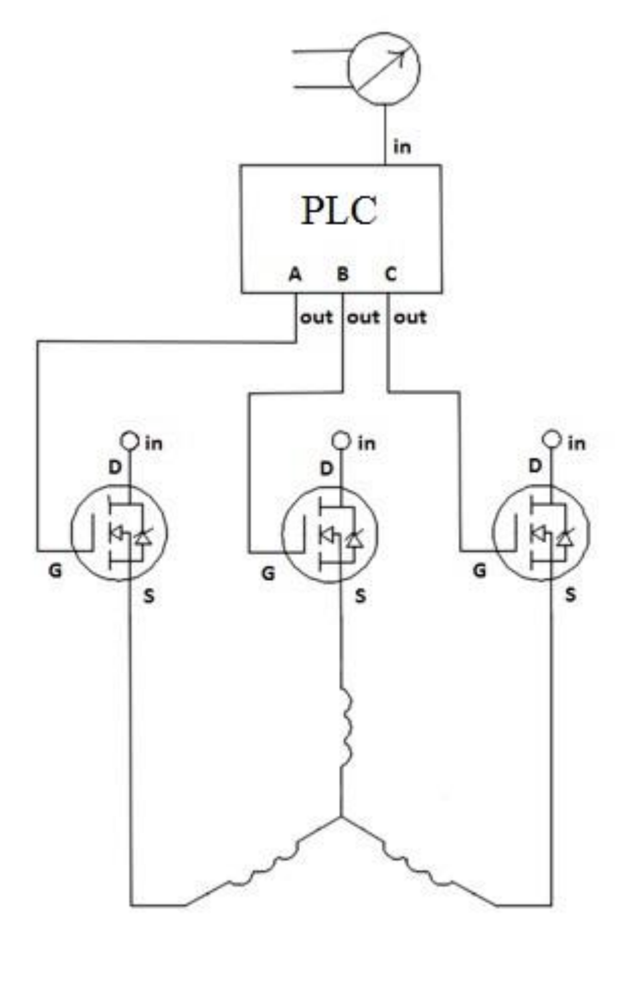
Hardware Implementation of Automatic Control System for Vortex MHD / MR devices



Differential pressure gauge:
1 – membrane,
2 – measuring electrical circuit,
3 – strain gauge bridge,
4 – power supply.

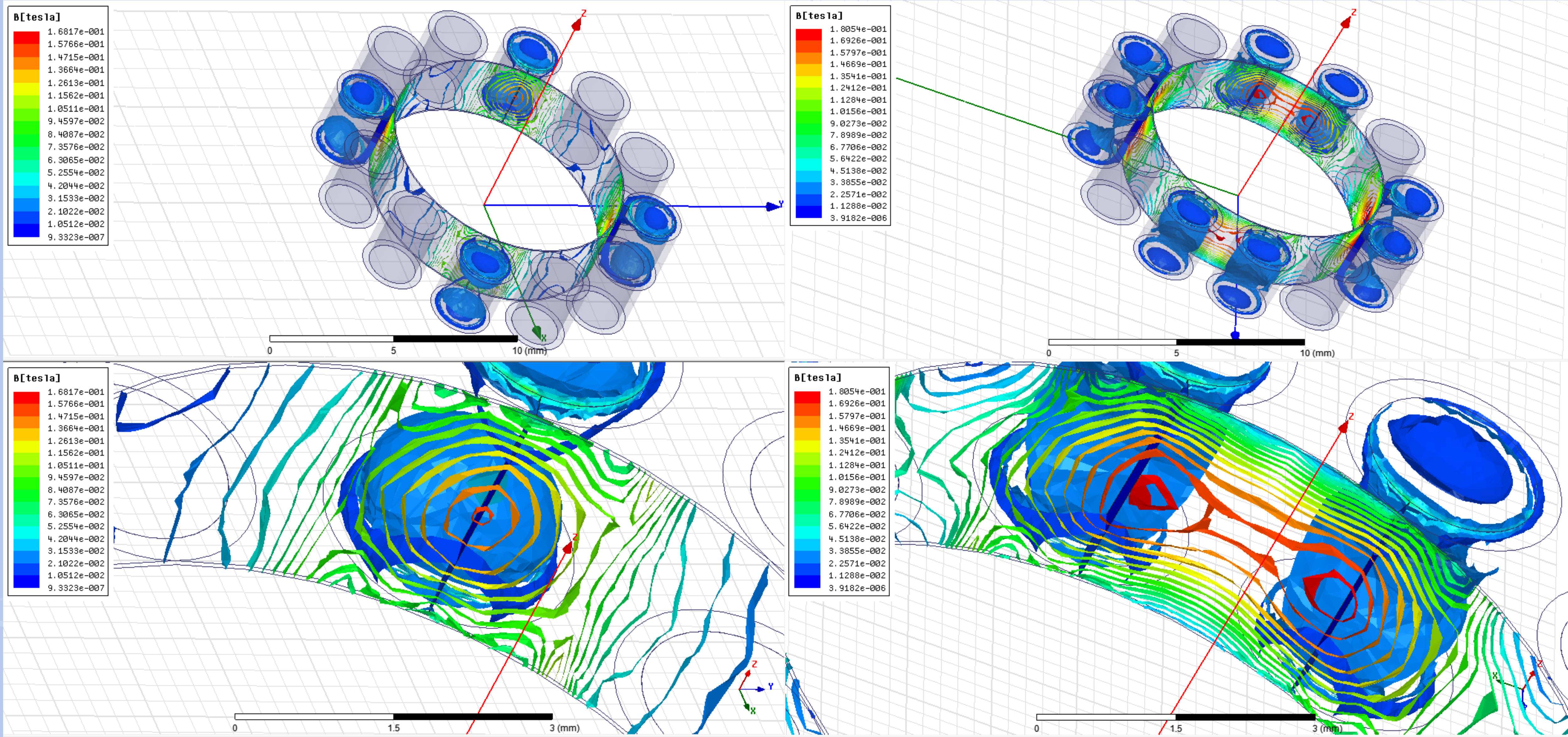


1 – MHD / MR device,
2 – differential pressure gauge.



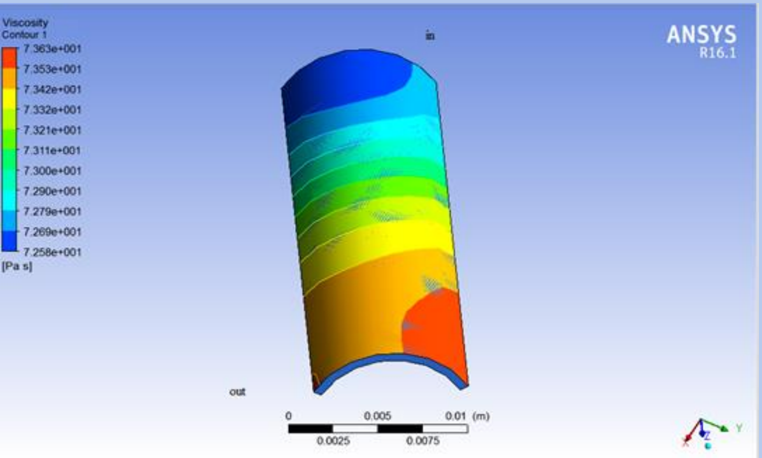
Wiring diagram of vortex MHD / MR devices

Magnetic-induction profile of vortex MHD / MR devices

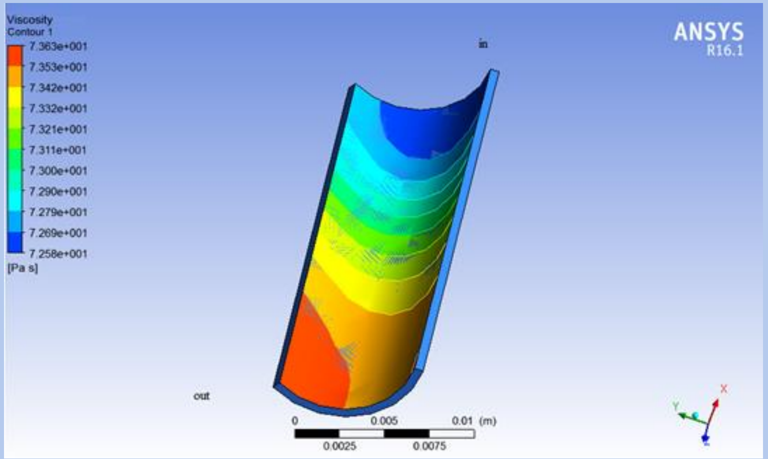


Computational fluid dynamic analysis of vortex MHD / MR devices in ANSYS Workbench

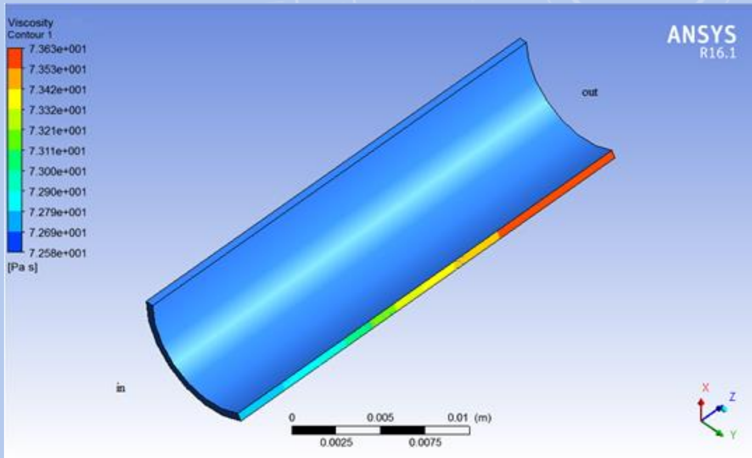
Dependence of viscosity characteristics on the parameters of the control magnetic field in the annular gap at initial viscosity 100 St (LINEAR MODE).



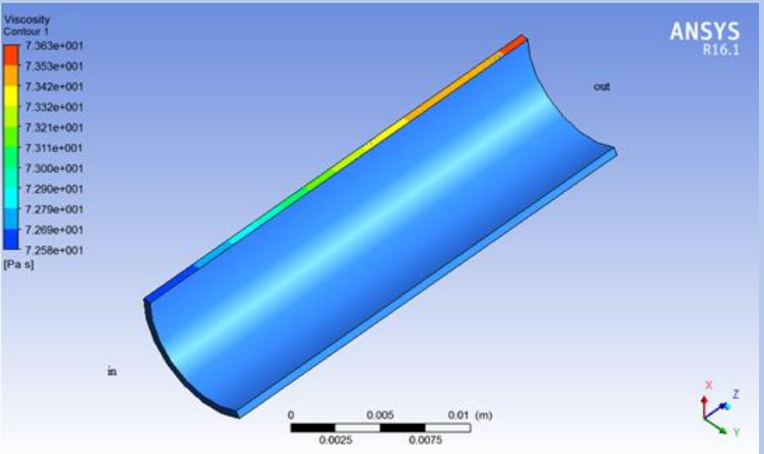
outer surface of segment 120^0



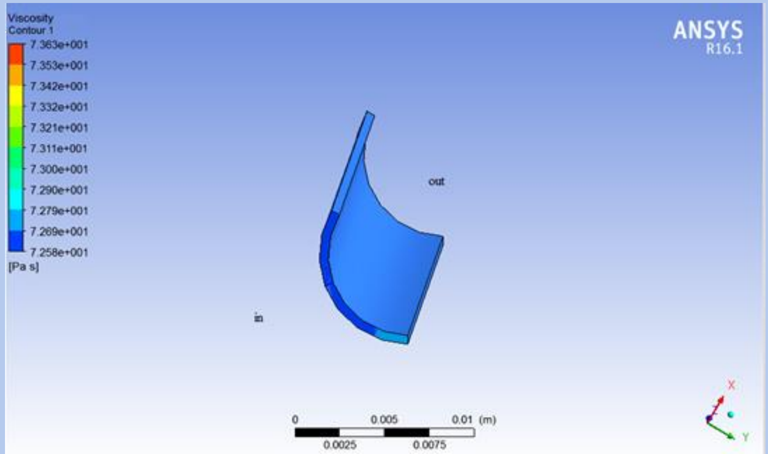
inner surface of segment 120^0



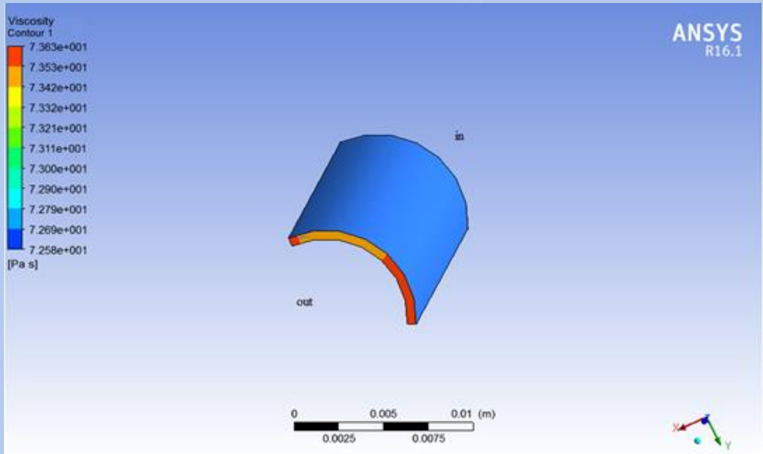
axial section of segment 120^0



axial section of segment 120^0



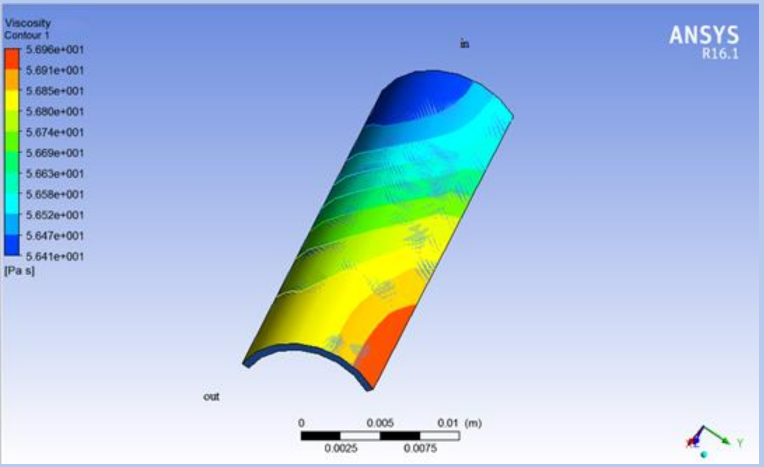
radial section (input) of segment 120^0



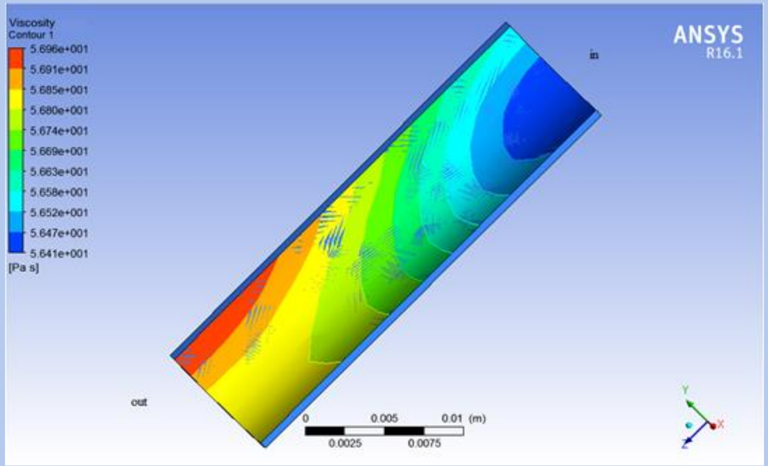
radial section (output) of segment 120^0

Computational fluid dynamic analysis of vortex MHD / MR devices in ANSYS Workbench

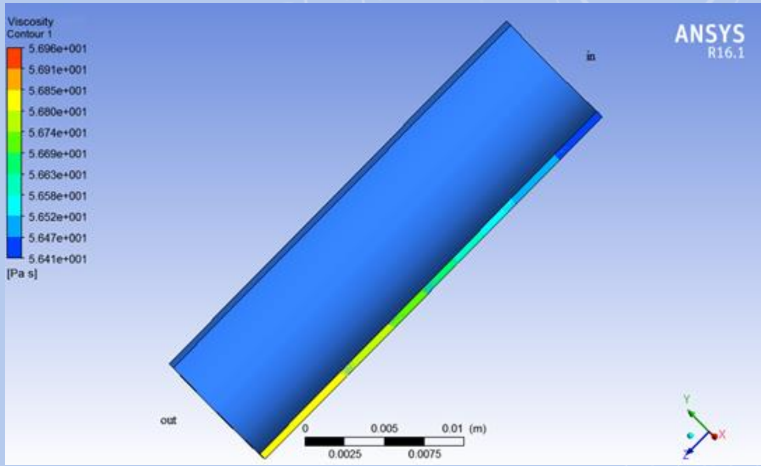
Dependence of viscosity characteristics on the parameters of the control magnetic field in the annular gap at initial viscosity 200 St (LINEAR MODE).



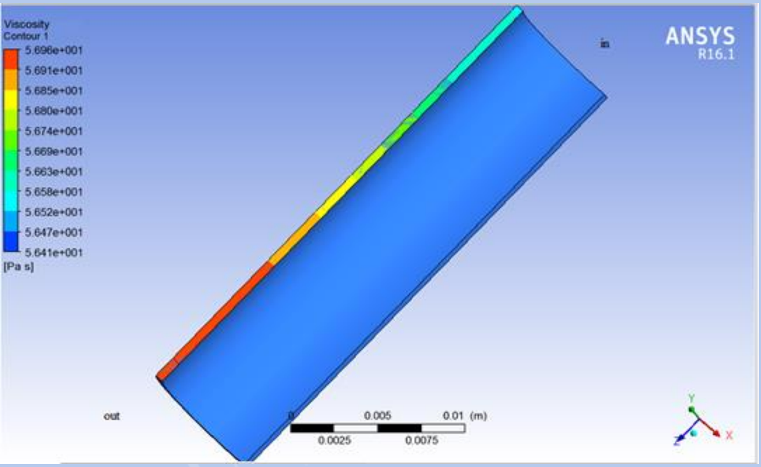
outer surface of segment 120^0



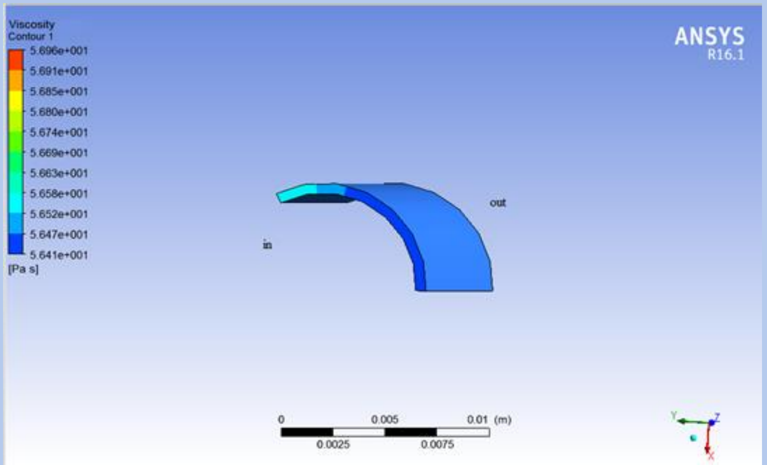
inner surface of segment 120^0



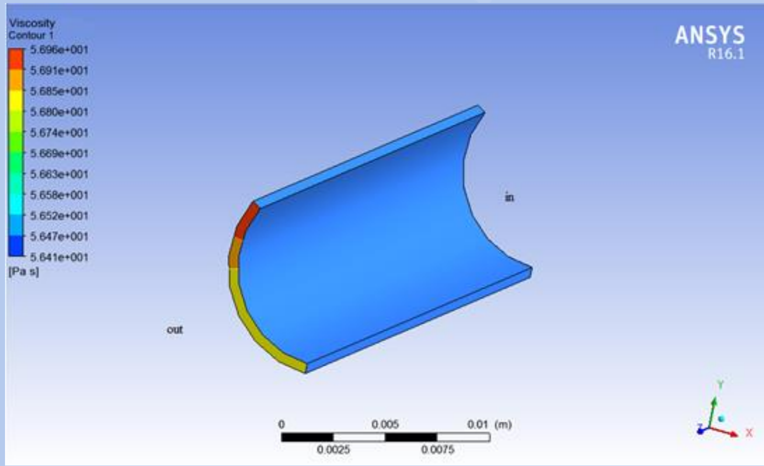
axial section of segment 120^0



axial section of segment 120^0



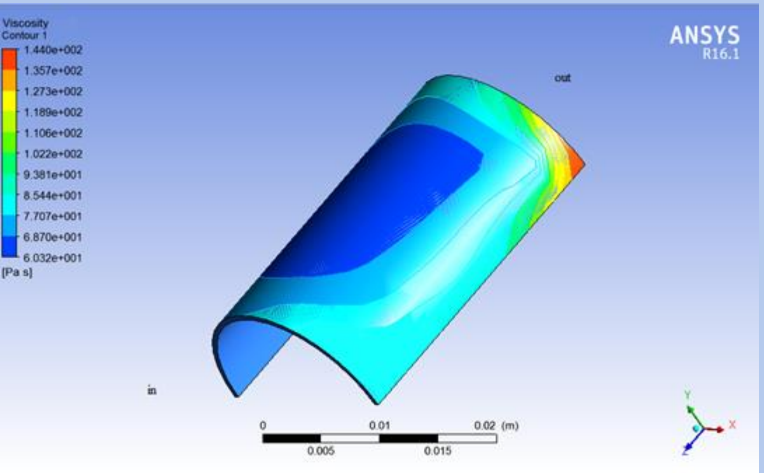
radial section (input) of segment 120^0



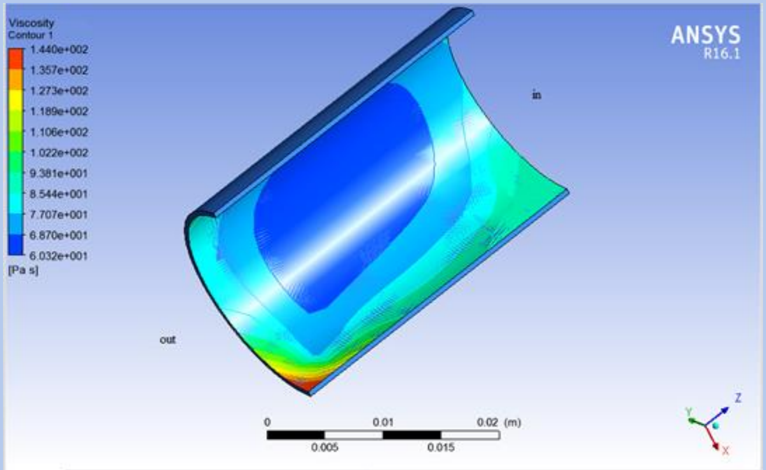
radial section (output) of segment 120^0

Computational fluid dynamic analysis of vortex MHD / MR devices in ANSYS Workbench

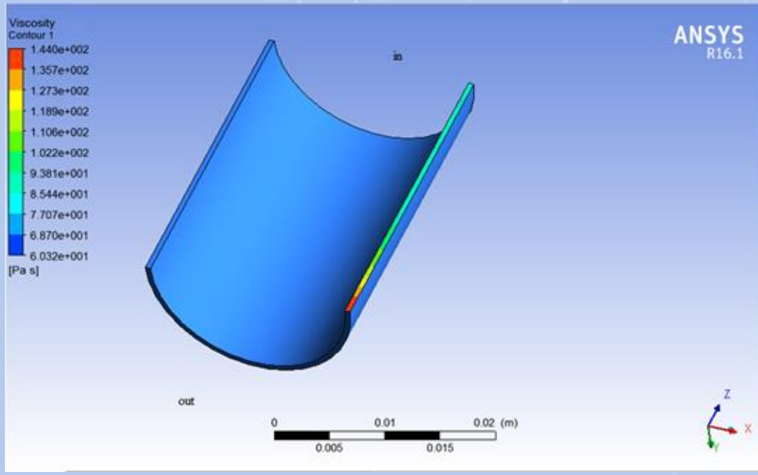
Viscosity distribution profile in the annular gap at initial viscosity 100 St (VORTEX MODE).



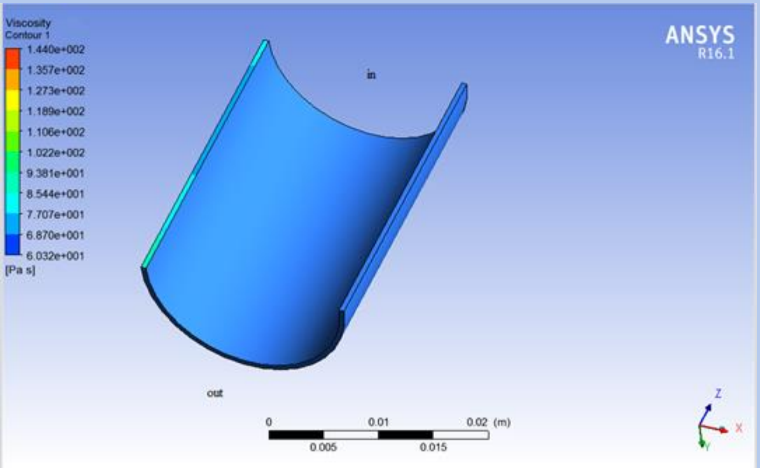
outer surface of segment 180^0



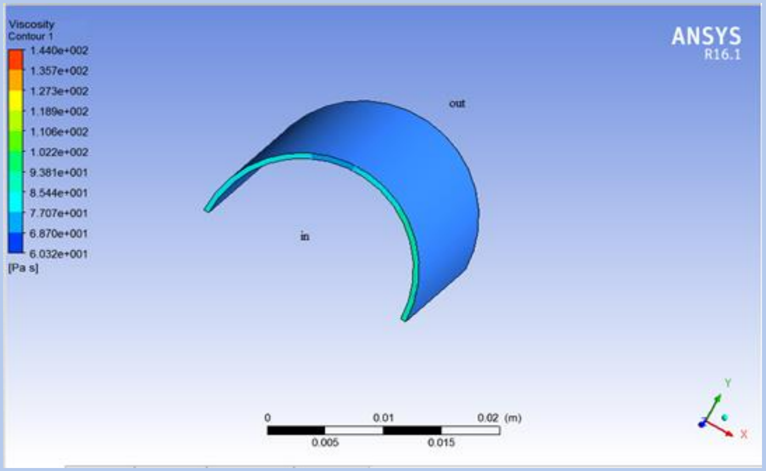
inner surface of segment 180^0



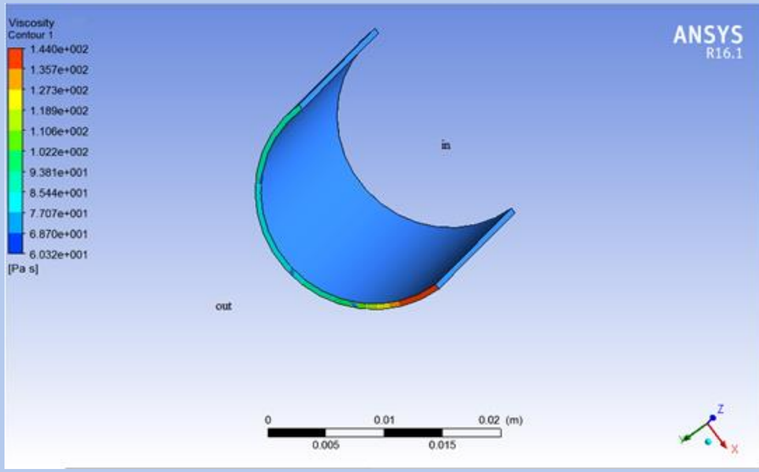
axial section of segment 180^0



axial section of segment 180^0



radial section (input) of segment 180^0



radial section (output) of segment 180^0

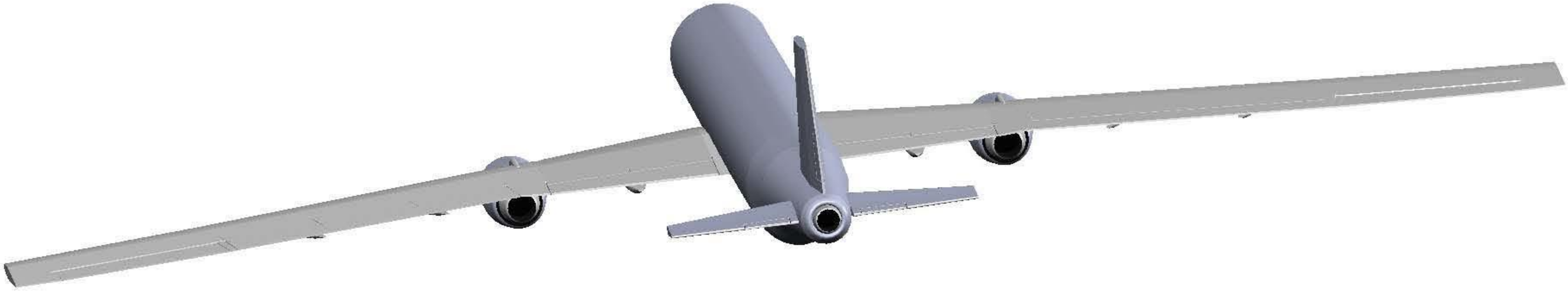
Innovations of rapidity drive systems with patented vortex electromagnetic field technology

The proposed magnetorheological control device construction (PATENTS: WO 2016/028182, RU 2634163) realizes the principle of combined flow rate control of magnetorheological fluid, which consists of the implementations of viscosity regulation and generation of hydrodynamic, rheological, and gyroscopic effects in magnetorheological environment by means of nonstationary (vortex) electromagnetic fields. Magnetorheological fluid begins to manifest the viscoplastic properties, if the volume of magnetorheological fluid is placed in sufficiently strong electromagnetic fields. Viscoplastic properties by dynamic loads provide the ability to lock the fluid flow at the expense of rheological effects, which are explained by change in the values of viscosity of viscoplastic environment by shear stress. Theoretically, by shear stress, the viscosity of viscoplastic environment tends to infinity. Rotating control electromagnetic fields report acceleration and radial velocity component to magnetic particles and model their trajectory. Magnetohydrodynamic pump construction with helical electromagnetic control fields (PATENTS: WO 2016/028181, RU 2634166) allows significant increase in the flow rate of magnetorheological fluid at small dimensions of the operating cavity and smaller values of the electromagnetic field parameters in comparison with analogue. This is achieved by application of spiral channel and nonstationary (helical) electromagnetic control field. The spiral trajectories of magnetic particles permits to transfer a greater amount of kinetic energy in comparison to linear acceleration of magnetic particles at same dimensions of electromagnets and operating cavity of magnetohydrodynamic pump. If operating cavity is executed in the form of spiral channel, it leads to set the radial velocity component and potentiates the occurrence of gyroscopic effects. The magnetorheological fluid control flow paths (PATENTS: WO 2016/028180, WO 2016/028181, WO 2016/028182, RU 192674, RU 2634163, RU 2634166) improve the dynamics and precision of hybrid hydraulic drive systems. The magnetorheological fluid control flow paths simplify also the regulation of drive system, because the magnetorheological fluid systems do not require a transformation of the input electrical signals to others forms of energy, which increases the speed of response of hydraulic drive system to control signals. Created magnetorheological and magnetohydrodynamic devices with nonstationary (vortex and helical) electromagnetic fields implement the combined control of flow rate; this makes it possible to extend the range of operating temperatures and pressures. The use of proposed constructions of magnetorheological and magnetohydrodynamic devices with nonstationary (vortex and helical) electromagnetic fields can save 35–50% of energy resources.

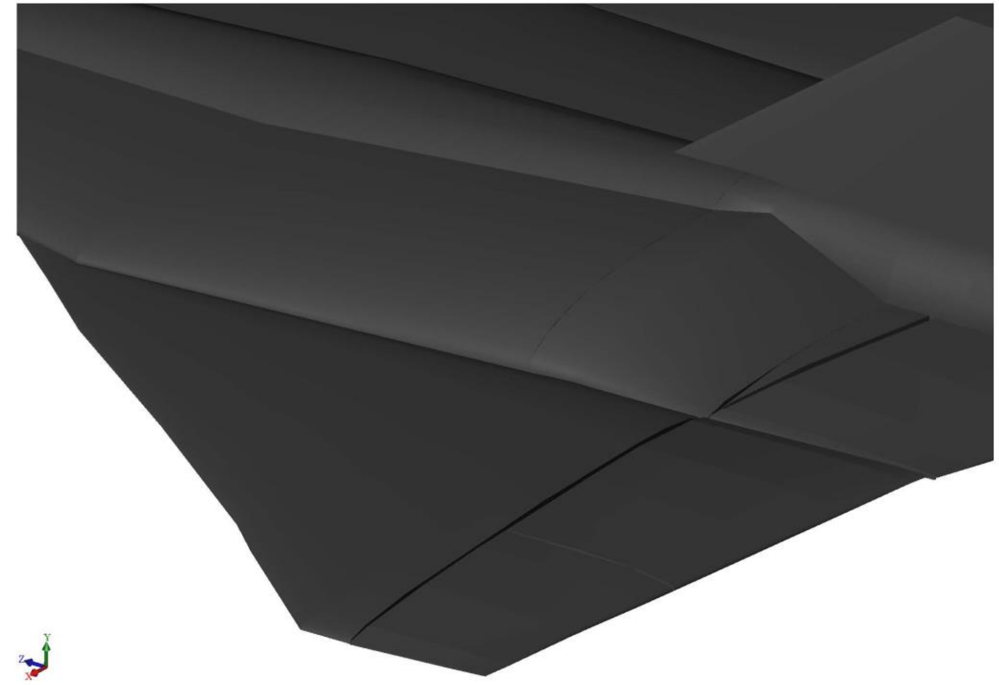
CURRENT STATUS

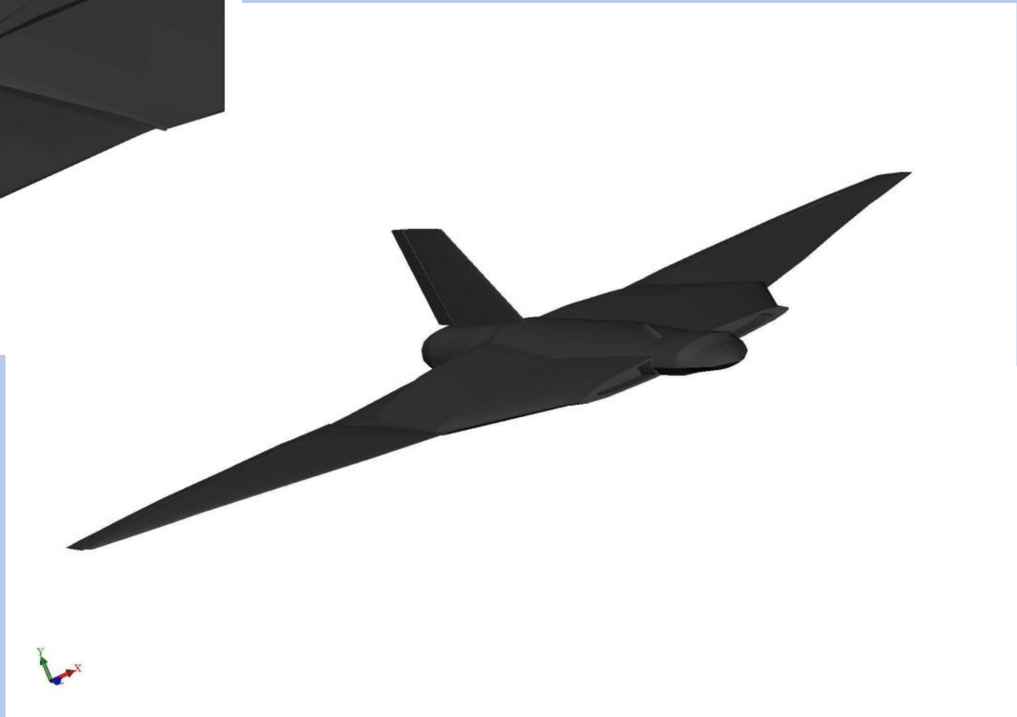
- We are at the stage of improvement of magnetorheological drive system specifications through computational analysis.
- We are preparing for full-scale dynamic testing of magnetorheological drive systems with patented vortex electromagnetic field technology.

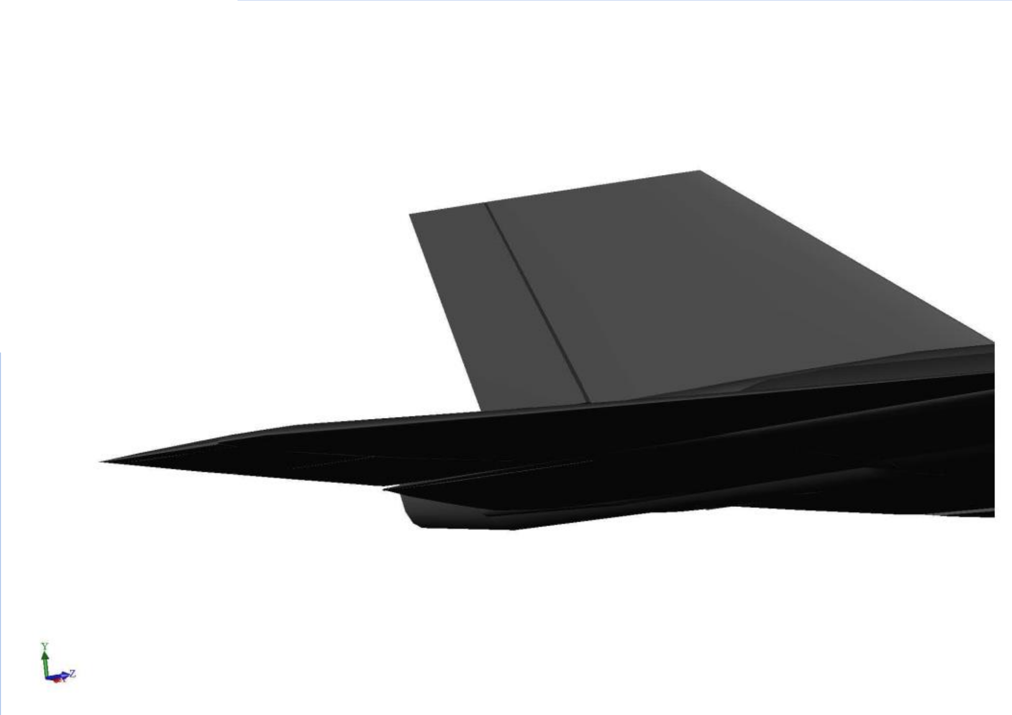
RELATED PROJECTS



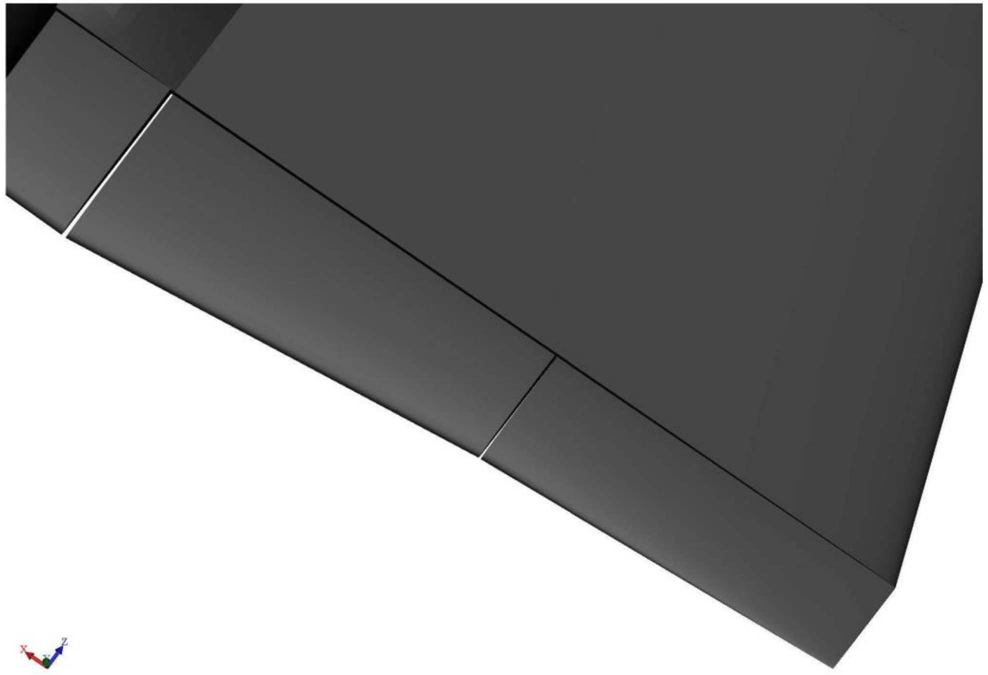
MJÖLLNIR



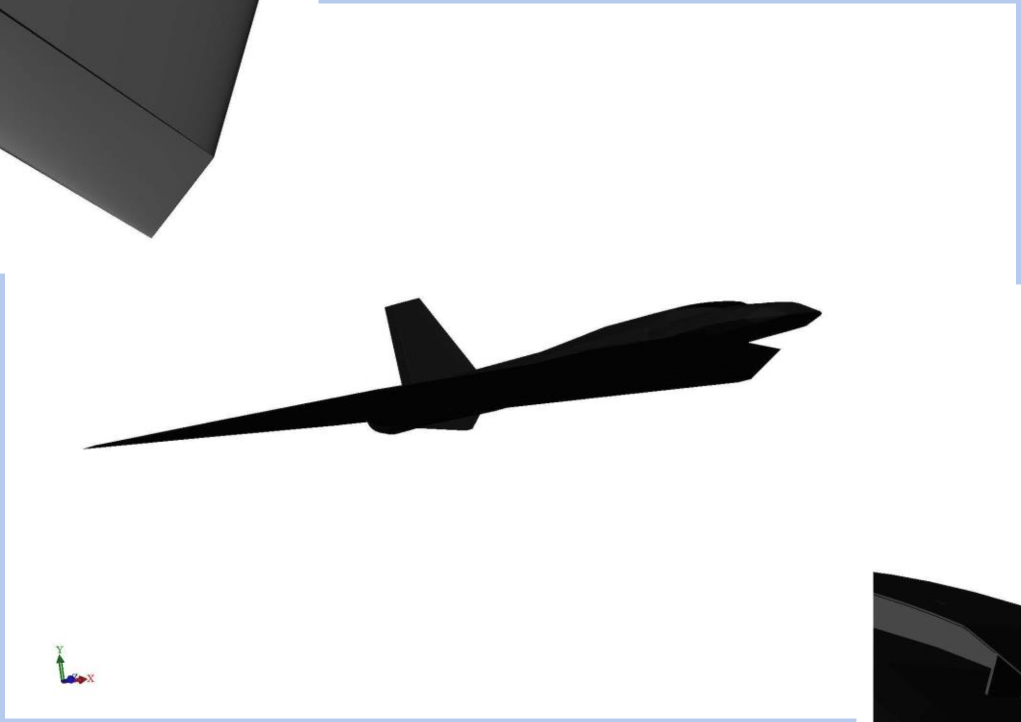


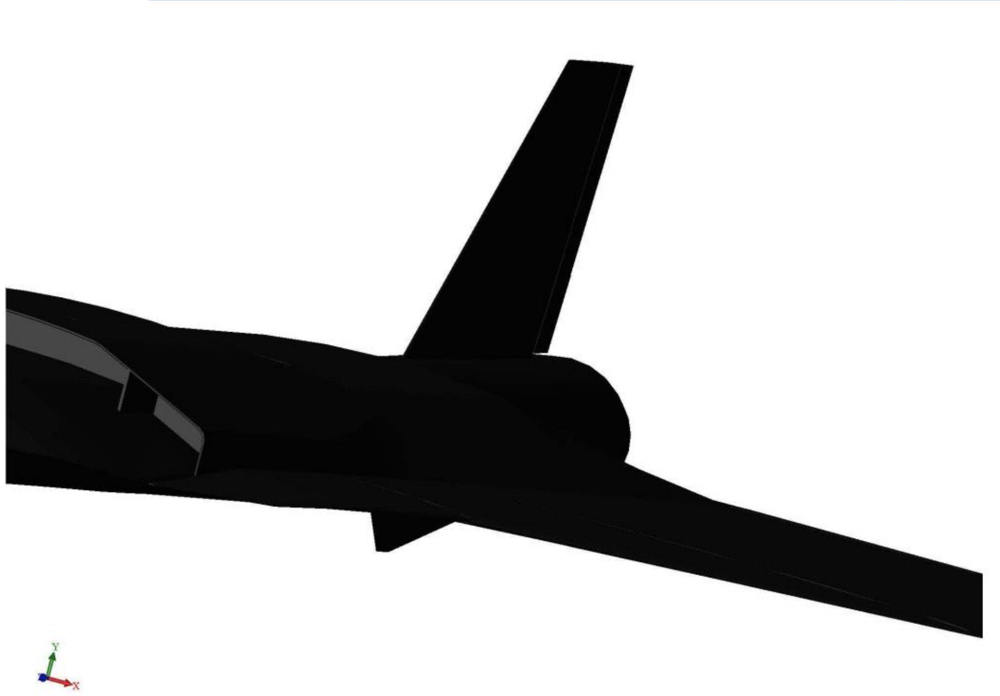


Our jet drone design concept



SHURIKEN





Our jet drone design concept

Our jet drone design concepts

The Mjöllnir and Shuriken jet drone design concepts include patented magnetorheological control surface drive systems.

OUR TEAM

Katharina Naigert Ph.D., Head of Project Management Office

Dr. Katharina Naigert specializes in the systems for aircraft and orbiter. Dr. Katharina Naigert was developing New Generation Magnetorheological, Magnetodynamic, and Ferrofluid Control Devices with Nonstationary Electromagnetic Fields. Dr. Katharina Naigert is also concerned with the research on hydro-, gas- and plasma dynamics.

Emil Rudyak Ph.D., Senior Developer

Dr. Emil Rudyak is activity from 1963 up to date, was concerned with the research on plasma technologies.
In particular, Dr. Rudyak was developing plasma generators with increasing Volt-Ampere characteristics, high enthalpy plasma stream and other types of plasma generators. Those plasma generators are applied for treatment on metals and raw materials in machining, metallurgy, plasma chemistry and plasma cutting.

Johnatan Brodsky, COO

M.Sc. Technology and Systems Management. Operation / Production and project manager, with extensive experience in the chemical process industry, John is highly Experienced in leading production processes, implementing engineering improvements for cost reduction, output efficiency, and improving product quality. Before he joined Plasmatron, he served as the Director of Operations at Dor Chemicals in Haifa.

Pinhas Uzan, Business Development Consultant

Pinhas is a highly decorated Ex military / police veteran. He has worked in Mexico for an international diamond company as a sales manager and for a multi-million dollar branch of the company as a store manager. Pinhas is a Microsoft Certified Desktop Technician and has worked in support of F1 computer systems. The field of metallurgy is his current area of interest along with natural remedies.

Elliott Silcoff Ph.D., in-house consultant

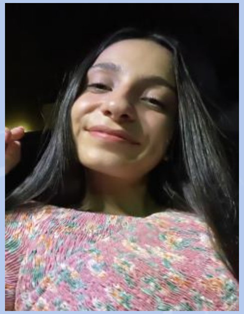
Graduate of the Hebrew University of Jerusalem and a postdoctoral fellow at the Weizmann Institute and Stanford University. 20+ years of experience in R&D with a number of released products and over 30 patents. Dr. Silcoff was a leading scientist and a head of research groups in many fields including electrochemistry, materials engineering and analysis.

Steve Daren Ph.D., in-house consultant

Ph.D. & M.Sc. in Chemistry, Weizmann Institute, B.Sc. (Honors) in Chemistry and Physics, Kings College, UK. 30+ years of experience in the chemical industry and academia. World renown expert and consultant for the chemical, pharmaceutical, polymer and plastics industries. Numerous patents in the field of agriculture, battery electrolytes.

Ariel Artur Mosheev, Business Development Consultant

Co-Founder of Plasmatron Waste Solution Ltd.
Ariel has a practical understanding of the technological needs of the enterprise and a remarkable ability to find the right people for different tasks. Ariel will be in charge of procurement management and contacts and work with key partners and subcontractors.



Berta Bracha Mosheev, CEO

Berta has a Certificate in accounting and Degree of Business manager specializing in Human Resources.

Rashmil Mamiev, Business Development Consultant

Entrepreneur. Co-Founder of Plasmatron Waste Solution Ltd.
Founder & Director of Brothers Mamiev Metal Industries and Construction Ltd.

Ofer Daren, Co-Founder of Plasmatron Waste Solution Ltd

Graduate of the College of Management. Founder of the Daren Innovation Center, a unique accelerator for technological start-ups. 10+ years of experience with working daily and closely with numerous start-ups and a deep understanding of the various needs and challenges of early-stage ventures.