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Non-Contact Flow Manipulation Using Magnetic Fields

-MagnetoFluidDynamic (MFD) approaches are promising for controlling electrically conductive fluids, however, they have not yet been developed for control of time-dependent fluid flows in 3D. The main issue with using MFD entails solving the mathematics involved in tuning the magnetic field to achieve the desired 3D fluid flow. Despite several studies on steady-state and time-dependent control, the optimal flow control of 3D fluid flow has remained unsolved.

Researchers at Arizona State University have created a novel magnetic approach for remotely controlling conductive fluids in 3D with high spatiotemporal resolution. This high-precision, non-contact approach allows for fluid flow manipulation with control of flow stability, flow measurement and mixing. The properties of the fluid can be tracked via sensors and feedback regarding the flow can be communicated and used to adjust the control system in real time.

This novel approach enables time-dependent 3D control of conductive fluids for applications in a variety of life science and physical science applications.

Potential Applications

- MFD
- Fluid Dynamics – drag reduction, turbulence control
- Microfluidics – contactless mixing, fluid handling & separation
- Healthcare – targeted drug delivery
- Metallurgy – silicon single crystal growth
- Electrochemistry

Benefits and Advantages

- Enables contactless vorticity control in fluids
- High spatiotemporal resolution control
- Remote control to achieve desired fluid flows in time and space
- Works in complex environments
- 3D flow control
- Allows for turbulence control, drag reduction, contactless mixing, crystal growth control and targeted drug delivery
- Can include sensors which communicate measurements for adjustment of different system parameters

For more information about the inventor(s) and their research, please see

Dr. Marvi's departmental webpage