Hybrid Piezoelectric And Pyroelectric Energy Harvester/sensor For Medical Applications

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Abstract

Piezoelectric materials are substances that can convert mechanical energy into electrical energy and vice versa. This is called the piezoelectric effect. When a piezoelectric material is squeezed or stretched, it creates an electric charge. This is because the material's atoms are arranged in a way that allows them to store electrical energy. When the material is deformed, these atoms are forced to move, which creates an electric field. The piezoelectric effect can be used to power devices or to sense physical parameters. The unique properties of piezoelectric materials make them useful in a variety of applications, such as sensors/energy harvesting and actuators. Pyroelectricity is the ability of certain materials to generate a temporary voltage when they are heated or cooled. The temperature change modifies the positions of the atoms slightly within the crystal structure so that the polarization of the material changes. Pyroelectric materials are used in a variety of applications, including fire alarms, thermal imaging, and humidity sensors. They are also being explored for use in energy harvesting and medical devices.
Some piezoelectric materials can also exhibit pyroelectric behavior. This means they can generate an electric charge when they are deformed (piezoelectric effect) or when their temperature changes (pyroelectric effect). This hybrid behavior of piezoelectric materials is very interesting because it means that they can be used to harvest both mechanical and thermal energy. A hybrid energy harvester is a device that can convert both mechanical and thermal energy into electrical energy. This type of harvester is often made from a piezoelectric material that exhibits both piezoelectric and pyroelectric behavior. Hybrid energy harvesters have a number of potential applications. They can be used to generate electricity from vibrations, such as those caused by footsteps or traffic. They can also be used to generate electricity from heat, such as that generated by the human body or by industrial processes.
In the present study, the hot fluid dynamics are used for the multiple energy capturing source. The proposed hybrid harvester harvests the electrical energy from the dynamics (piezoelectric effect) and temperature (pyroelectric effect) of the fluid. The development of hybrid energy harvesters is an active area of research. As the technology continues to improve, hybrid energy harvesters could become a valuable source of renewable energy. The simulation studies consist of eigenfrequencies and frequency domain analysis of a hybrid energy harvester using COMSOL Multiphysics.

Figures used in the abstract

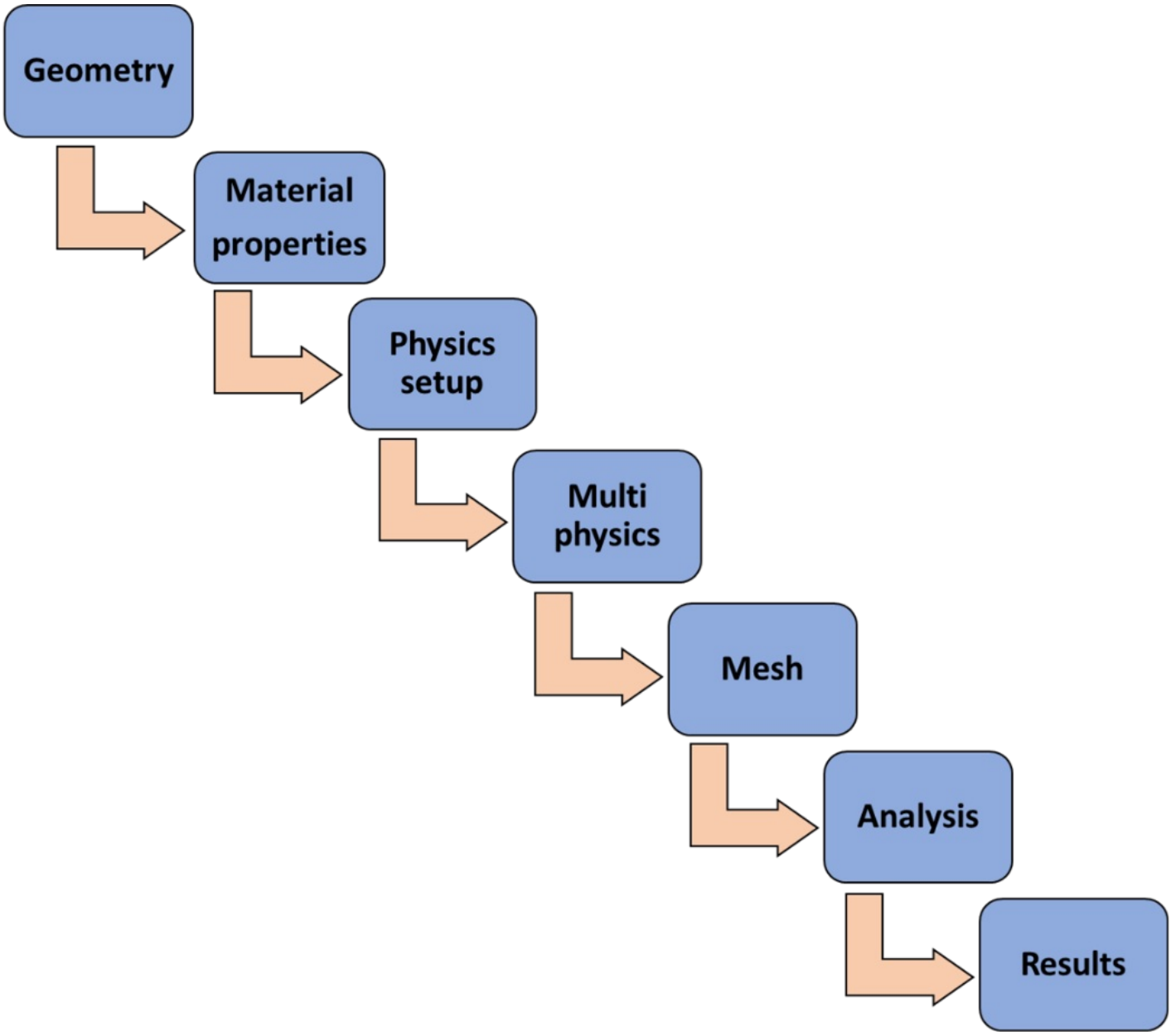
Geometry
Material properties
Physics setup
Multi physics
Mesh
Analysis
Results

Figure 1