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Body Shape Control of Magnetic Soft Continuum Robots with PID Controller

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Abstract : Magnetically guided soft robots have emerged as a promising technology in minimally invasive surgery due to their ability to adapt to complex environments. However, one of the main challenges in this field is damage to the vascular structure caused by unwanted stress on the vessel wall and deformation of the vessel due to improper control of the shape of the robot body during surgery. Therefore, this article proposes an approach for controlling the form of a magnetic, soft, continuous robot body using a PID controller. The magnetic soft continuous robot is modelled using Cosserat theory in static mode and solved numerically. The designed controller adjusts the position of each part of the robot to match the desired shape. The PID controller is considered to minimize the robot's contact with the vessel wall and prevent unwanted vessel deformation. The simulation results confirmed the accuracy of the numerical solution of the static Cosserat model. Also, they showed the effectiveness of the proposed contouring method in achieving the desired shape with a maximum error of about 0.3 millimetres.

Keywords : PID, magnetic soft continuous robot, soft robot shape control, Cosserat theory, minimally invasive surgery
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