In this paper, we present a medical robot that safely and rapidly cannulates peripheral blood vessels-a procedure commonly known as venipuncture" Balter et al (2017).

Abstract:

Robotic systems have slowly entered the realm of modern medicine; however, outside the operating room, medical robotics has yet to be translated to more routine interventions such as blood sampling or intravenous fluid delivery. In this paper, we present a medical robot that safely and rapidly cannulates peripheral blood vessels-a procedure commonly known as venipuncture.

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The device uses near-infrared and ultrasound imaging to scan and select suitable injection sites, and a 9-DOF robot to insert the needle into the center of the vessel based on image and force guidance. We first present the system design and visual servoing scheme of the latest generation robot, and then evaluate the performance of the device through workspace simulations and free-space positioning tests. Finally, we perform a series of motion tracking experiments using stereo vision, ultrasound, and force sensing to guide the position and orientation of the needle tip. Positioning experiments indicate sub-millimeter accuracy and repeatability over the operating workspace of the system, while tracking studies demonstrate real-time needle servoing in response to moving targets. Lastly, robotic phantom cannulations demonstrate the use of multiple system states to confirm that the needle has reached the center of the vessel.

Reference:

Balter, M.L., Chen, A.I., Maguire, T.J. and Yarmush, M.L. (2017) Adaptive Kinematic Control of a Robotic Venipuncture Device Based on Stereo Vision, Ultrasound, and Force Guidance. IEEE Transactions on Industrial Electronics. 64(2), p.1626-1635.

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