Fiber Optic Distal Sensor Controlled Drug Injector

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Technology description

INVENTION NOVELTY

Motion-compensated high-precision drug injector using a fiber optic distal sensor to monitor, in real time, the relative position between the injector tip and the tissue. The linear motion controls the injector tip position based on the sensor input to compensate for the unwanted tissue and hand motions for precise control of the injection depth.

VALUE PROPOSITION

We describe a motion-controlled drug injector integrated with a common–path swept source optical coherence tomography (CP-SSOCT) based fiber distal sensor. The injector is connected to a linear motion motor that can accurately and precisely inject drug at a specific site or layer with accuracy on the order of 10 μm. In our study, the injection depth is maintained by the sensor- controlled PZT motor with a step resolution of <5 μm, which also significantly reduces the hand tremor of the surgeon using a closed-loop proportional-integral-derivative (PID) control algorithm based on graphics processing unit (GPU) processing. Biological tissues of swine heart and tomato flesh were employed to test the performance of the injector.

TECHNICAL DETAILS

We have a CP-SSOCT-based intelligent high precision injector, that could theoretically inject drugs at a specific site with a resolution on the order of 10 μm. The drug injection depth is maintained by an active PZT motor, which could also significantly reduce hand tremor of the surgeon using a closed-loop PID control algorithm based on GPU computing. Swine heart was employed to test the performance of the injector in biological tissue. Potential applications of this novel technology might include but not be limited to tissues as delicate as retina or as robust as injection heart by adjusting the diameter of the needle and target injection depth to avoid localized hemorrhage and delicate tissue destruction at the injection site.

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