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A temperature-controlled laser hot needle with grating sensor for liver tissue tract ablation

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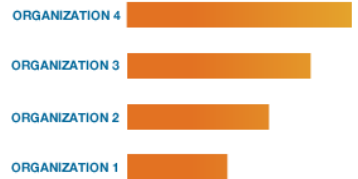
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Abstract: In this work, we proposed a laser hot needle for liver tissue tract ablation. The proposed laser hot needle is powered by a 450 nm diode laser incorporated with a closed-loop control system that comprises of a uniform Fiber Bragg Grating (FBG) temperature sensor and a computer. Based on the real-time feedback input from the FBG temperature sensor, the laser power is regulated by a proportional-integral-derivative (PID) control system to control the needle temperature. In the characterization test, a chirped grating-based distributed temperature sensor is employed for measuring the tissue temperature profile in the ex-vivo bovine liver tissue during the ablation. A histological test is conducted to study the impact of tract ablation to the cellular structures of treated tissue and tissue coagulation. In a tract ablation test, a ~50 mm ×

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In this work, we proposed a laser hot needle for liver tissue tract ablation. The proposed laser hot needle is powered by a 450 nm diode laser incorporated with a closed-loop control system that comprises of a uniform Fiber Bragg Grating (FBG) temperature sensor and a computer. Based on the real-time feedback input from the FBG temperature sensor, the laser power is regulated by a proportional-integral-derivative (PID) control system to control the needle temperature. In the characterization test, a chirped grating-based distributed temperature sensor is employed for measuring the tissue temperature profile in the ex-vivo bovine liver tissue during the ablation. A histological test is conducted to study the impact of tract ablation to the cellular structures of treated tissue and tissue coagulation. In a tract ablation test, a ~50 mm ×

~6 mm (length × width) thermal denaturation zone has been created on ex-vivo bovine liver tissue with the laser hot needle at 150°C.

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