

摘要: 为了实现对人体消化道的无损检查及治疗, 基于结肠主动检查和肿瘤热疗的控制要求, 设计并实现了结肠诊疗微机器人控制系统。系统由结肠诊疗机器人系统的硬件组成模块和硬件电路; 基于射频双向无线通信, 给出了软件通信流程和通信时序的实时性要求。之后, 驱动机构完成仿尺蠖的蠕动运动, 并采用PID型广义预测算法控制加热线圈对肠道实施热疗, 控制转台角度可旋转观察肠壁图像。最后, 通过管道动物活体实验, 验证了系统的控制性能。实验结果表明: 射频双向通讯可在0.6 s内完成控制命令的发送和诊断数据的接收, 机器人运动稳定, 视频摄像头可查看肠道前方和侧壁0~360°的图像, 对肠道肿瘤实施热疗能在50 s内稳定到热疗温度设定值。设计的系统基本满足人对肠道实时检查和热疗的要求。

关键词: 诊疗机器人 结肠 射频双向通信 控制系统

Control system design of micro diagnosis and treating robot for colonoscopy

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Abstract: To realize the non-contact inspection and treatment of human gastro-intestines, a control system with directional Radio Frequency(RF) was designed for a micro robot to heat the cancer of colon. First, the modules of control system and its hardware configuration were established. Then, the software program was completed and movement control was efficiently implemented according to the timing sequence presented in this paper. More driving mechanism was used to simulate the inchworm movement and the generalized predictive control algorithm PID was introduced into the heat therapy. The control of a micro turning table could provide 0~360° positioning cameras to show the video of colon tube in rotation. Finally, the system performance was tested as well. Experimental results indicate that the average RF communication time is 0.6 s and the step of the robot movement is continuous. The angle of camera view can be changed from 0° to 360°, and the heat treatment can be stabilized in 70 s. The experimental results demonstrate the effectiveness and reasonability of this control system and it satisfies the requirements of real time inspection and thermal therapy for colons.

Keywords: medical micro robot colon bi-directional RF communication control system

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