

Article

Real-time PCR Machine System Modeling and a Systematic Approach for the Robust Design of a Real-time PCR-on-a-Chip System

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Abstract: Chip-based DNA quantification systems are widespread, and used in many point-of-care applications. However, instruments for such applications may not be maintained or calibrated regularly. Since machine reliability is a key issue for normal operation, this study presents a system model of the real-time Polymerase Chain Reaction (PCR) machine to analyze the instrument design through numerical experiments. Based on model analysis, a systematic approach was developed to lower the variation of DNA quantification and achieve a robust design for a real-time PCR-on-a-chip system. Accelerated life testing was adopted to evaluate the reliability of the chip prototype. According to the life test plan, this proposed real-time PCR-on-a-chip system was simulated to work continuously for over three years with similar reproducibility in DNA quantification. This not only shows the robustness of the lab-on-a-chip system, but also verifies the effectiveness of our systematic method for achieving a robust design.

Keywords: DNA quantification reliability; robust design; system identification model; real-time PCR machine; real-time PCR on-a-chip

1. Introduction

Wittwer *et al.* first began to develop real-time Polymerase Chain Reaction (PCR) machines in 1997 [1,2]. This type of instrument has an integrated fluorimeter to allow in-tube real-time analysis of DNA template samples. A rise in fluorescence of the signal of each cycle indicates amplification. The ability

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Computer-Based Design Tamir Shahin,2002-08-30 A collection of papers from a conference held at Kings College London Computer based Design focuses on all areas of design using computational methods and examines how all these individual tools can be integrated to produce a coherent design process This volume also covers areas of manual design methods and modelling that are vital to the continuing development and evolution of the computer aided design process TOPICS COVERED INCLUDE Product design and modelling Design process Decision making models Computer assisted design systems Computer assisted conceptual design Computer assisted detailed design Computer assisted design for manufacture Design knowledge manipulation Engineering change Engineering design issues Fuzzy design Computer aided design Industrial applications of design Advanced design applications Computational fluid dynamics Computer based Design provides an excellent opportunity for an update on the latest techniques and developments from concept to advanced application in the design arena

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