

Ultra Low-Power Biomedical Signal Processing

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Ultra Low-Power Biomedical Signal Processing

An Analog Wavelet Filter Approach
for Pacemakers

 Springer

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Foreword

As microelectronics has matured in human controlled tools like computers, another era of ubiquitous microelectronics is well underway. Compact, robust and dedicated microelectronic systems are combined with actuators and sensors in an increasing number of life-critical controls. Familiar questions from computer like: “Are you sure you want to do this? (Press OK to proceed)”, are not possible in these self-contained, autonomous control systems. These embedded control systems must make immediate decisions based on whatever information is available from the provided sensors.

The most challenging of these embedded control system are the devices implanted in humans. Not only do they control life-critical functions, but they have to do so under severe power and size constraints. In addition, the sensed signals are often noisy and weak, demanding complicated and computationally intensive signal processing. In spite of these challenges, cardiac pacemakers are implanted in hundreds of thousand humans every year. Some reports indicate battery lives exceeding twenty years of operation.

The implantable pacemaker was first introduced in the late 1950s and has been refined and improved in a number of ways since then. This new book “Ultra Low-Power Biomedical Signal Processing – An Analog Wavelet Filter Approach for Pacemakers” by SANDRO A. P. HADDAD and WOUTER A. SERDIJN is addressing the core problems of efficient linear and nonlinear, signal processing in biomedical devices in general, with special emphasis on pacemaker electronics. The proposed analog wavelet filter approach is demonstrated to be a power efficient and flexible method for integrated pacemaker electronics.

This book should be appreciated by anybody in need of power-efficient, linear and non-linear signal processing suitable for microelectronics. A balanced and understandable discussion of trade-offs towards the more traditional Fourier analysis exposes the benefits of wavelet filters. For pacemakers typical time-domain information like the QRS complex of the ECG signal is sought. Another important insight is how to use the log-domain (dynamic translinear) circuit technique for power efficient electronics. Convincing results are provided.

Although the primary device addressed in this book is the implantable pacemaker, the authors indicate the general properties and usefulness of

wavelet filters in general, not only for biomedical applications. The completeness of wavelet filter theory combined with the transition to practical circuits make this book mandatory for everybody aiming at power efficient embedded control systems.

Oslo, November 2008

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