



Early History and Challenges of Implantable Electronics

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Implantable systems for biomedical research and clinical care are now a flourishing field of activities in academia as well as industrial institutions. The broad field includes experimental explorations in electronics, mechanical, chemical, and biological components and systems, and the combination of all these. Today virtually all implants involve both electronic circuits and micro-electro-mechanical-systems (MEMS). This article offers a very brief glance back at the early history of implant electronics in the period from the 1950s to the 1970s, by employing selected examples from the author's research. This short review also discusses the challenges of implantable electronics at present, and suggests some potentially important trends in the future research and development of implantable microsystems. It is aimed as an introduction of implantable/attached electronic systems to research engineers that are interested in implantable systems as a section of Biomedical Instrumentations.

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1. INTRODUCTION

Implantable systems represent an important technique of biomedical instrumentation for sensing body information or soliciting body reaction within living organs to remote locations through wireless communication links. Figure 1 shows the conceptual diagram of an implant system (Figure 1(a)) and the essential blocks of a typical implant device (Figure 1(b)). In Figure 1(a), the circle is the body and the rectangular block is the external equipment. The implant systems can function as telemetry (remote or tele-sensing) or tele-actuation. Linking both together it is a closed loop remote control system. It may be all electronic or may have parts of the implant be mechanical, chemical or biological. Most implantable electronic devices have same essential blocks whether the implant device is for sensing, actuating, or closed loop control. In implantable telemetry devices, the sensors convert the biological and/or physiological parameters into electrical signals that are processed by the interface electronics then transmitted by radio-frequency (RF), or other wireless means links to an external receiver and recording or processing facilities. In implantable actuation

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