Bi-directional wireless data transfer for an implanted cortical visual prosthesis

Citation for published version (APA):

Document license:
Unspecified

Document status and date:
Published: 25/01/2018

Document Version:
Author's version before peer-review

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher’s website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:
www.tue.nl/taverne

Take down policy
If you believe that this document breaches copyright please contact us at:
openaccess@tue.nl
providing details and we will investigate your claim.
Bi-directional Wireless Data Transfer for an Implanted Cortical Visual Prosthesis

A.E. Omisakin, R.M.C Mestrom and M.J. Bentum

Eindhoven University of Technology, Department of Electrical Engineering, Electromagnetics Group

Contact: a.e.omisakin@tue.nl

Abstract

There are approximately 40 million blind people in the world. Making them see again has been a long-desired goal of science [1]. In most of the cases of blindness, the retina is damaged and most of the visual pathway as well. In that case, the only viable option left is to stimulate the visual cortex directly by an implanted intracortical visual prosthesis. Such a system consists of an external camera capturing the images, an external processor to convert the data into signals suited for the implanted prosthesis, and a wired or wireless connection to the implanted electrode array subsystem. Stimulation through the implanted electrodes will create phosphenes to restore a (rudimentary) form of vision in a patient. A wireless link between the external processor and the implanted electrode array sub-system is strongly preferred over wires to avoid infections and to enable free movement [2]. The uplink carries the recorded signal, whereas the downlink contains the stimulation signal for the implant. The implanted transceiver module will be placed just beneath the skin. The overall system will be the first large-scale (1000 electrodes), wireless, chronically implanted simultaneously stimulating and recording intracortical visual prosthesis based on penetrating electrodes. The goal is to develop a low-power implanted transceiver that meets the required downlink rate of about 200 kbps, and the uplink rate of 170 Mbps which is effectively 23 Mbps after compression. For the uplink, impulse radio ultra-wideband (IR-UWB) is considered while an inductive transfer of data using band-pass sampled differential phase shift keying (DPSK) with power cancellation mechanism is considered for the downlink.

Currently, system level design and simulations are carried out. Next step is the circuit level design. After promising simulation results, a demonstrator board will be developed after which full IC integration will commence. The system will ultimately be tested in monkeys, first with an external wireless setup, and finally with an implanted transceiver. A first estimate for the link budget shows that a surplus of 6 dB remains after closing the uplink from the implant to the neck using IR-UWB. Based on ultra-low power communication techniques, it is projected that the maximum power consumption of the implanted transceiver module will be around 30 mW.

A low-power high data-rate bi-directional link between the implant side and the external processor of the high count electrode visual prosthesis is well within reach using bandpass sampled DPSK for the downlink and IR-UWB for uplink. The system will bring us closer to empowering blind people to see again with more pixels than ever.

References


Figure 1: (a) Concept, (b) Electrodes & implanted transceiver, (c) System block of implanted transceiver