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E DELL'INFORMAZIONE

Title

Tesi di Laurea Magistrale in
Xxxxxxx Engineering - Ingegneria Xxxxxxx

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Abstract

Here goes the Abstract in English of your thesis followed by a list of keywords. The Abstract is a concise summary of the content of the thesis (single page of text) and a guide to the most important contributions included in your thesis. The Abstract is the very last thing you write. It should be a self-contained text and should be clear to someone who hasn't (yet) read the whole manuscript. The Abstract should contain the answers to the main scientific questions that have been addressed in your thesis. It needs to summarize the adopted motivations and the adopted methodological approach as well as the findings of your work and their relevance and impact. The Abstract is the part appearing in the record of your thesis inside POLITesi, the Digital Archive of PhD and Master Theses (Laurea Magistrale) of Politecnico di Milano. The Abstract will be followed by a list of four to six keywords. Keywords are a tool to help indexers and search engines to find relevant documents. To be relevant and effective, keywords must be chosen carefully. They should represent the content of your work and be specific to your field or sub-field. Keywords may be a single word or two to four words.

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Abstract in lingua italiana

Qui va l'Abstract in lingua italiana della tesi seguito dalla lista di parole chiave.

Parole chiave: qui, vanno, le parole chiave, della tesi

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1 | Introduction

1.1. PNRelay project

Peripheral nerve injuries (PNI) are mainly caused by surgery and trauma and are common in clinical practice, with 13 to 23 per 1,00,000 people typically suffering from PNI. [4] Traumatic injury to peripheral nerves is a significant cause of morbidity and disability today. Different types of extremity trauma can result in specific damage to particular nerves associated with that limb. Extremity trauma may be obvious as to its location, but the depth, severity, and underlying structures involved are not always clear. [3] Common etiologies of acute traumatic peripheral nerve injury (TPNI) include penetrating injury, crush, stretch, and ischemia. Management of TPNI requires familiarity with the relevant anatomy, pathology, pathophysiology, and the surgical principles, approaches and concerns. [1] The PNRelay project has been presented as a collaboration effort between the Politecnico di Milano and the Politecnico di Torino. The objective of the project is to target this problem developing a new peripheral nerve interface, capable of conveying information between brain and organs. This kind of medical devices generally record the electrical stimulus travelling within the nerve, analyze it and finally artificially stimulate the nerve below the injury to replicate the natural response of the body.[2] The device that has been engineered as part of the PNRelay is made of two main subparts: one that is implanted and one that is external.
The internal implant includes cuff electrodes for signal acquisition, the Senseback ASIC chip [19] for signal processing, enclosed within a biocompatible capsule, and a transdermal port for wireless device powering. Extra-neural cuff electrodes, positioned externally on the nerve's surface, are chosen for their lower invasiveness in acquiring ENG data [20]. The data transmission module, which is responsible for data signal processing, is currently being developed for full-body integration. The external component hosts the classifier, which by performing an online operation, allows the different stimuli to be recognized. The signal is then sent to the stimulator, which proceeds to close the loop. The overall scheme for animal testing is shown in Figure 1.1. During initial experimental phases, the classifier may operate on a computer connected to the external circuit, with the ultimate

objective being its integration into the implanted circuitry. Due to the typically substantial variations in neurological data among individuals, classification algorithms in this domain are often tailored to specific subjects [3]. This further compounds the challenge of gathering a sufficient amount of biological data on same subject. Challenges persist in decoding neural signal information due to limitations imposed by acquisition invasiveness. While extra-neural cuff electrodes represent a less invasive option for chronic implantation [21], the classification of sensory stimuli recorded through them remains complex due to a limited SNR. Various techniques have been explored to address this challenge [22]–[24], but the optimal classification approach remains an open area for further research and exploration.

1.1.1. PNRelay Setup

1.1.2. Ethical concerns

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2.2. Nervous Systems

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4 | Conclusions and future developments

A final chapter containing the main conclusions of your research/study and possible future developments of your work have to be inserted in this chapter.

Bibliography

[1] W. W. Campbell. Evaluation and management of peripheral nerve injury. *Clinical Neurophysiology*, 119(9):1951–1965, Sept. 2008. ISSN 1388-2457. doi: 10.1016/j.clinph.2008.03.018.

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[3] C. A. Taylor, D. Braza, J. B. Rice, and T. Dillingham. The Incidence of Peripheral Nerve Injury in Extremity Trauma. *American Journal of Physical Medicine & Rehabilitation*, 87(5):381, May 2008. ISSN 0894-9115. doi: 10.1097/PHM.0b013e31815e6370.

[4] S. Zhang, M. Huang, J. Zhi, S. Wu, Y. Wang, and F. Pei. Research Hotspots and Trends of Peripheral Nerve Injuries Based on Web of Science From 2017 to 2021: A Bibliometric Analysis. *Frontiers in Neurology*, 13, May 2022. ISSN 1664-2295. doi: 10.3389/fneur.2022.872261.

A | Appendix A

If you need to include an appendix to support the research in your thesis, you can place it at the end of the manuscript. An appendix contains supplementary material (figures, tables, data, codes, mathematical proofs, surveys, ...) which supplement the main results contained in the previous chapters.

B | Appendix B

It may be necessary to include another appendix to better organize the presentation of supplementary material.

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List of Symbols

Variable	Description	SI unit
$\boldsymbol{u}$	solid displacement	m
$\boldsymbol{u}_f$	fluid displacement	m

Acknowledgements

Here you might want to .