



Università
degli Studi
di Palermo

Dipartimento di Ingegneria
Direttore: prof. Antonino Valenza



Allegato 1

Scheda di partecipazione per l'assegnazione di fondi per Progetti di Ricerca sviluppati da singolo Ricercatori – Anno 2023

TITOLO DELLA RICERCA

Real-time Tracking of **Dynamic** Physiological Network Interactions (**ReaDy**)

PAROLE CHIAVE

1	Signal processing
2	Information Theory
3	Brain and physiological interactions
4	System Identification

PROPONENTE/COORDINATORE

COGNOME E NOME Antonacci Yuri

RUOLO Ricercatore TD (RTD-A)

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SSD ING-INF/06

EVENTUALI COLLABORAZIONI

N.	COGNOME E NOME	RUOLO	UNIVERSITA'/ORGANIZZ. ESTERNA
1	Minati Ludovico	Research professor	University of Electronic Science and Technology (China)
2	Mijatovic Gorana	Assistant Professor, Researcher	University of Novi Sad (Serbia)
3	Daniele Marinazzo	Full Professor	University of Ghent (Belgium)



SCOPO, DESCRIZIONE E RISULTATI ATTESI DELLA RICERCA

Stato dell'arte (max 10 righe):

The human organism comprises various physiological organ systems, each with its own structural organization and functional complexity, whose output signal display complex and transient dynamics. Network Physiology (NP) combines empirical and theoretical knowledge from various disciplines to gain insights into the dynamic interactions of diverse organs, physiological systems, and sub-systems as a network, with the aim of understanding how these interactions generate different physiological states. A fundamental unresolved question is how to quantify, predict and control emergent global behaviours in networks of diverse dynamic systems interacting through various forms of coupling. Such investigation envisages the development of new analytic methodologies, computational tools and theoretical frameworks capable of probing organ interactions from continuous streams of data that are simultaneously applicable to diverse organ systems with different output dynamics.

Obiettivi, ipotesi e metodologia (max 12 righe):

Unlike traditional complex network theory, where edges/links are constant and represent static graphs of association, our approach entertains a dynamic perspective. Specifically, we propose to track in real-time the transient dynamics of organ communication using time-varying parametric models. This approach offers a comprehensive depiction of how various organs dynamically interact, encompassing both time and frequency domains. The specific aims will be: 1) The development of a new strategy based on Information theoretic measures to quantify time-varying information flow between different physiological systems exhibiting non-stationary dynamics. 2) The use of the new approach in two real contexts: (i) physiological data recorded at LOOX laboratory from different physiological districts; (ii) real functional near infrared spectroscopy (fNIRS) signals recorded from healthy subjects during a breath-holding task recorded at ESDP lab. The project's feasibility is guaranteed by the presence of pre-existing databases and strong knowledge about dynamic systems identification, as well as the engagement of external researchers through pre-established collaborations for each of the project's activities.

Risultati attesi (max 5 righe):

The project aims to provide new tools for the quantitative analysis of interacting physiological systems in which collective behaviours and time-variant interactions coexist across varying states and conditions. The implemented tools will enable the monitoring of brain activity and its interactions with, for instance, cardiovascular and cardiorespiratory systems in the challenging condition posed by real contexts. Such investigation will increase the knowledge about the dynamic organization of physiological networks.

Caratteristiche di interdisciplinarietà del progetto (max 5 righe):

The activities proposed are inherently interdisciplinary as they combine expertise in the field of biosignal acquisition and analysis (SSD: ING-INF06, ING-INF/01). Indeed, the project proposes to develop and combine signal processing and system identification tools and to apply them to biomedical signals acquired



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through electronic devices designed and realized directly in the laboratories of UNIPA (LOOX Laboratory headed by Prof. Busacca and ESDP lab headed by Prof. Giaconia).

DESCRIZIONE DEL PRODOTTO DELLA RICERCA (tipologia, collocazione editoriale, co-autore straniera eventualmente previsto, tempi attesi)

No. 1 publications in one of the following journals:
1) IEEE Transaction of Biomedical Engineering (Q1)
2) Biomedical Signal Processing and Control (Q1)
3) IEEE Access (Q1)

No. 1 publication on indexed conference paper

1) 13th ESGCO meeting: Zaragoza (Spain) 23-25 OCT 2024

expected time for publication: 9 months

One co-author is foreign and two Italians but belonging to Chinese and Belgian institutions already co-authored several articles published in previous years

FINANZIAMENTO RICHIESTO (max 1.500,00 €)

1.500,00 €

DESCRIZIONE DELLE SPESE PREVISTE

-Conferences and meetings: 750 €

-Publications costs: 750 €

Il sottoscritto, proponente del progetto, dichiara:

– di non avere disponibilità di fondi di ricerca per un importo superiore a 5.000 €

Luogo e data: Palermo 24/10/2023

Firma F.to Yuri Antonacci