Decree of the Rector n. 1300 of 04/12/2023
Competition for awarding 1 research grant at the University of Udine

DISCLAIMER:
The official and legally binding call for applications is in Italian only.
This document cannot be used for legal purposes and is only meant to provide information in English on the call for applications (Decree of the Rector n. 1300 of 04/12/2023). Please refer to the official call published on: https://www.uniud.it/it/albo-ufficiale

Any change and integration will be made available on the above mentioned web page. Therefore, no personal written communication regarding the examination date and/or competition results shall be provided to applicants.

Annex 1

Competition announcement for the assignment of 1 research grant at the University of Udine, entitled “ECG processing for intelligent diagnostic and quality of life improvement” SSD: ING-INF/03 (principal investigator, Riccardo Bernardini)

Research grant funded by the resources of the project PRIN 2022 - Prot. n. 2022A49KR3

Art. 1
A selection procedure is hereby launched for the award of 1 research grant at the University of Udine, as identified in Attachment A which constitutes an integral part of the present announcement. The research grant is linked to the research project and is subject and conditioned upon the relative funding. The fellowship may be renewed, in compliance with Art. 22, Law No. 240 of 30 December 2010 (as in the text in force before the implementation of the Conversion Law of the D.L. 36/2022, L. 79/2022), Law No. 11 of 27 February 2015, and the current regulations of the University of Udine for awarding research grants, issued with the Rector’s Decree No. 182 of 31 March 2021. The renewal is subject to the scientific coordinator’s positive assessment of the researcher’s activities, an adequate scientific rationale, and a corresponding financial covering.

The research fellowship does not give rise to any right with regards to accessing University posts.

Any personal communication to candidates related to this selection will be sent exclusively to the email address indicated when registering for the selection, as mentioned in Art. 5.

Art. 2
The research grant described in this competition announcement and the required qualifications to apply for the position are identified in Attachment A. The lack of the admission requirements leads to the automatic exclusion from the competition procedure.

Possession of a PhD or equivalent degree obtained abroad or, only for the interested areas, of a medical specialization accompanied by an adequate scientific production, constitutes a preferential qualification for awarding the research fellowship of this selection, if it has not been provided as a mandatory requirement.
For the only purpose of the admission to the competition, the Examining Board (Art. 7) shall assess the equivalence of the qualification obtained abroad, except for the evaluation of the medical specialization qualification to which Article 38 of the Legislative Decree 165/2001 and subsequent modifications and additions, and EU regulations on the matter, shall be applied.

The Examining Board will proceed to the evaluation of the qualification obtained abroad according to the documentation attached to the application form. The Examining Board may exclude the candidate if the submitted documentation does not provide sufficient information for the assessment. Therefore, applicants must enclose all the documentation in their possession relating to their qualification in order to provide the Examining Board with sufficient information for assessment.

Candidates holding a qualification issued by a European Research Area country, if successful, must submit, if not already attached to the application form one of the following options:
- Supplement Diploma in English issued by the competent University.
- CIMEA Certificate of comparability of the foreign qualification, issued by CIMEA (Information Centre on Academic Mobility and Equivalence) via the “diplome” service at https://cimea.dipломa.eu/udine/#/auth/login

Candidates holding a qualification issued by a non-European Research Area country, if successful, must submit, if not already attached to the application form one of the following options:
- Declaration of the on-site value of the qualification and the certificate relating to the degree with examinations and grades. A certificate in a language other than Italian or English must be accompanied by an official translation into one of these languages (certified by the competent diplomatic-consular authority or certified by a court in Italy).
- CIMEA Certificate of comparability of the foreign qualification, issued by CIMEA (Information Centre on Academic Mobility and Equivalence) via the “diplome” service at https://cimea.dipломa.eu/udine/#/auth/login

If the Supplement Diploma or the statement/attestation of comparability are not available when signing the contract, the applicant must demonstrate that he/she has requested the documentation and submit it as soon as possible.

Any exclusion from the selection procedure due to lack of eligibility requirements, absence of required documents, failure to sign the selection application or submission of the selection application in a manner different from what is provided for in this call for applications will be communicated to applicants exclusively at the email address indicated in the application form.

Art. 3
The research grant referred to in this call for applications cannot be awarded:

a. to employees of Universities and the entities referred to in Article 22, section 1, of Italian Law no. 240 of 30 December 2010 (in the text prior to the reform introduced by Law no. 79 of 29 June 2022);
b. to those who have already been awarded research grants pursuant to Italian Law no. 240 of 30 December 2010 (prior to the reform introduced by Law no. 79 of 29 June 2022) for the maximum period provided by law, even if not continuously, excluding the period in which the grant was used in conjunction with the doctorate, up to the legal term of the relative course;
c. to those who have already benefited from research grants and fixed-term researcher contracts provided for, respectively, in Articles 22 and 24 of Italian Law no. 240 of 30 December 2010 (in the
text prior to the reform introduced by Law no. 79 of 29 June 2022), for a total of 12 years, even if not consecutive;

d. to anyone who has a degree of kinship or affinity, up to and including the fourth degree, with:
   - the Rector, the Director General or a member of the Board of Directors of the University of Udine;
   - the scientific supervisor or a professor/researcher belonging to the department or organisation hosting the research grant in question.

The research grant provided for in this call for applications cannot be combined:

a) with scholarships of any kind, except for those granted by Italian or foreign institutions to supplement, by means of stays abroad, the fellow's training or research activities;

b) with other research grants;

c) with an employment relationship, even if part-time, without prejudice to the relevant provisions for employees of public administrations.

The grant awarded under this call for applications is also incompatible with simultaneous attendance at university degree courses, either Bachelor's degree or Master’s degree courses, research Doctorates with scholarships and medical specializations, in Italy or abroad.

Art. 4

Applicants must enclose with their application, under penalty of exclusion, the following documents:

a) their professional scientific CV, highlighting the candidate's aptitude for carrying out and implementing the research project (Attachment A);

b) their identity card, their passport or any other identification document¹;

c) (for candidates with a foreign qualification only) certification or self-certification of both the academic qualification required for the admission to the selection, and of the exams (with evaluation) taken during the period of study abroad, and of any other document that can be useful to the evaluation of the degree by the Examining Board.

Applicants can attach to the application, publications and any other certification considered useful to demonstrate the qualification based on the research program (Attachment A) and to certify any research activity accomplished at public or private institutes (indicating the starting and ending date and the duration).

The documents and qualifications mentioned above must be submitted in Italian or English. Those that are not as requested will not be evaluated. Documents originally written in a language other than Italian or English must come with a translation in Italian or English, that the candidate will do on its own responsibility. The translation can be an abstract concerning the thesis.

Italian and Community candidates wishing to submit qualifications referring to conditions and facts attested by Public Administrations must proceed exclusively with self-certification.

Non-EU citizens legally residing in Italy may self-certify only data that can be verified or certified by Italian public bodies. They may also use declarations in lieu when provided for by an international convention between Italy and the declarant's country of origin.

Non-EU citizens not residing in Italy cannot self-certify.

Only the qualifications possessed by the candidate on the date the application form is submitted and submitted in accordance with the procedures set out in Article 5 will be assessed.

¹ Please be aware that the residence permit is not an identification document.
Failure to submit mandatory documents provided for in this article will constitute grounds for exclusion from the selection.

Art. 5
The submission of the applications for the present call starts on December 14, 2023 at 2:00 pm (Italian time) and ends on February 14, 2024 at 2:00 pm (Italian time).

The application to take part in the selection must be completed, under penalty of exclusion, using the appropriate online procedure, available at the link [https://pica.cineca.it/](https://pica.cineca.it/).

The procedure involves an applicant registration step, for those who do not already have an account, and then an application completion step.

Once completed, the online application must be signed in the manner described in the online procedure (manual signature with attached identity document or digital signature), under penalty of exclusion from selection. The application does not have to be signed if you access the above-mentioned online procedure using your SPID ID.

The qualifications referred to in Article 4 must be attached to the application in .pdf format. Individual .pdf files may not exceed 30MB.

The application for participation in the selection is automatically sent to the University of Udine with the definitive closing of the online procedure.

The University Administration:
- is not responsible if it is impossible to read the submitted documentation in electronic format due to damaged files;
- shall not accept or take into consideration qualifications or documents received in paper form or by any means other than what is specified in this article.

Reference to documents or publications already submitted in connection with other competitions is not allowed.

The Administration is not responsible for any missing document or communication because of inaccurate indication of residence and/or address submitted by the candidate during the application. Also, the Administration is not responsible if the candidate has not communicated changes in this information, or has communicated them too late. The Administration is also not responsible for any postal or telegraphic problems not attributable to the Administration itself.

Applicants are advised not to wait until the last few days before the closing date to submit their application. The University accepts no responsibility for any malfunctions due to technical problems and/or overloading of the communication line and/or application systems.

Art. 6
The selection procedure is held in accordance with the modality indicated in Attachment A.

The test will aim to assess the general preparation, experience and aptitude for research of the candidate. It will consist in the evaluation of the professional scientific curriculum, of the publications and qualifications presented, and of the interview, where foreseen.
Art. 7

The Examining board for the competition is identified in Attachment A of the present competition announcement, of which it is an integral part.

At its first meeting, the Examining board shall appoint its President and Secretary, and establish the criteria and methods for evaluating the qualifications and the interview, where foreseen.

The results of the qualifications assessment must be disclosed to applicants during the interview, where foreseen.

The Examining board can award a maximum of 100 points (one hundred out of one hundred) to the selection.

At the end of the evaluation procedure, the Examining board shall formulate the general merit list based on the overall score of each candidate, and draw up the minutes of the whole competition procedure.

Based on the ranking list, the assignment is awarded to candidates who have obtained a minimum overall score of 70/100 (seventy out of one hundred).

The Examining board's judgement is final.

The ranking list will be made public exclusively through publication on the University's official website.

Applicants will not be notified of the outcome of the evaluation.

Those who do not declare their acceptance of the research grant and do not present themselves at the research centre within the deadline communicated by the latter, even if not formally, shall lose the right to receive it. Exceptions to this term will only be granted in cases of documented force majeure.

Art. 8

The activity activity cannot be started before signing the contract defining the terms and conditions of the collaboration.

The activity covered by the research grant must have the following characteristics:

a) it must be carried out as part of the research programme covered by the grant and not be a merely technical support to it;

b) it must have a close connection with the realization of the research program for which the winner of the grant has been awarded the contract;

c) it must be continuous and, in any case, temporally defined, not merely occasional, and in coordination with the overall activity of the University;

d) it must be carried out autonomously, solely within the limits of the programme prepared by the programme supervisor, without predetermined working hours.

The researcher is required to submit a detailed written report on the work carried out and the results achieved, accompanied by the opinion of the scientific supervisor, to the reference organisation at the intervals set out in the contract. The researcher must also submit interim reports and timesheets, if requested by the reference organisation.
Either the fellow or the reference organisation may withdraw from the contract. The reference organisation may terminate the contract not only in the cases referred to in Article 9, sections 2 and 3, of the "Internal rules for awarding research grants pursuant to law 240 of 30 December 2010" of the University of Udine, but also in the event the research project and therefore the financial coverage on which the research grant is based cease to exist.

**Art. 9**

The following legal dispositions shall apply to the grant referred to in this call for applications:
- for tax matters, the provisions of Article 4 of Italian Law no. 476 of 13 August 1984, as subsequently amended and supplemented;
- for social security matters, the provisions of Article 2(26) et seq. of Italian Law no. 335 of 8 August 1995, as subsequently amended and supplemented;
- for mandatory maternity leave, the provisions of the Italian Ministerial Decree of 12 July 2007;
- with regard to sick leave, the provisions of Article 1(788) of Italian Law no. 296 of 27 December 2006 and subsequent amendments.

During the period of mandatory maternity leave, the allowance paid by INPS according to Art. 5 of the Italian Ministerial Decree of 12 July 2007 is supplemented by the University up to the full amount of the research grant.

The grant will be paid in monthly instalments.

**Art. 10**

The data collected as part of the procedure referred to in Art. 5 are necessary to properly manage the selection procedure, for any subsequent management of the research grant and for purposes related to managing services provided by the University. The University of Udine is the Data Controller. At any time, the data subject may request access, rectification and, depending on the University's institutional purposes, cancellation and restriction of processing or oppose the processing of their data. The data subject can always lodge a complaint with the Italian Data Protection Authority. The complete disclosure is available on the University of Udine website in the "Privacy" section, accessible from the home page www.uniud.it Direct Link: https://www.uniud.it/it/it/pagine-speciali/guida/privacy

**Art. 11**

For all matters not expressly mentioned in this call for applications, refer to the regulations in force on the subject cited in the introduction and to the "Internal rules for awarding research grants pursuant to Italian Law no. 240 of 30 December 2010" of the University of Udine, issued by Rector's Decree no. 182 of 31 March 2021.

**Art. 12**

The Responsible office at the University of Udine is "Area Servizi per la Ricerca - Ufficio Formazione per la Ricerca", via Mantica n. 31 - 33100 Udine, Italia.

To request information about the call for applications, please complete the following form available on the University of Udine website:
https://helpdesk.uniud.it/SubmitSR.jsp?type=req&accountld=universityofudine&populateSR_id=42105
Attachment A

Responsible scientifico della ricerca / Principal investigator:

Nome e cognome / Name and surname: Riccardo Bernardini
Qualifica / Position: Professore Associato / Associate Professor
Dipartimento / Department: Politecnico di Ingegneria e Architettura (DPIA) / Polytechnic of Engineering and Architecture
Area MUR / Research field: 09 - Ingegneria industriale e dell’informazione
Settore concorsuale e Settore scientifico disciplinare / Scientific sector: 09/F2; ING-INF/03 - Telecomunicazioni

Titolo dell’assegno di ricerca / Topic of the research fellowship “assegno di ricerca”:
I bandi sono consultabili dal sito dell'Ateneo, del MUR e di Euraxess / The calls are available on the University, MUR and Euraxess websites

Testo in italiano:
Elaborazione dell’ECG per la diagnostica intelligente ed il miglioramento della qualità di vita.

Text in English:
ECG processing for intelligent diagnostic and quality of life improvement.

Obiettivi previsti e risultati attesi del programma di ricerca in cui si colloca l’attività dell’assegnista di ricerca / Foreseen objectives and results of the research programme performed by the research fellow “assegnista di ricerca”:
I bandi sono consultabili dal sito dell'Ateneo, del MUR e di Euraxess / The calls are available on the University, MUR and Euraxess websites

Testo in italiano:
L’ECG è uno degli strumenti diagnostici più comuni. I metodi di deep learning hanno ottenuto risultati promettenti nell'ambito dell'assistenza sanitaria predittiva utilizzando i segnali ECG. Un trend di pubblicazioni in crescita esponenziale negli ultimi anni presenta diverse architetture di deep learning che sono state utilizzate in vari campi di analisi dell’ECG, come il rilevamento/classificazione di malattie, l'annotazione/localizzazione, lo studio degli stadi del sonno, l'identificazione biometrica e il denoising. Due delle frontiere interdisciplinari più promettenti in questo campo sono: 1) la valutazione dello stress e del tempo di reazione cardiaca nell'ambito della guida sicura e 2) il rilevamento delle emozioni. Il pieno sfruttamento delle informazioni ECG nel contesto più ampio del benessere individuale e sociale è ancora agli inizi. La disponibilità di dispositivi in grado di raccogliere segnali fisiologici sta aprendo la possibilità di nuovi scenari di raccolta e interpretazione dei dati che saranno affrontati in questo progetto PRIN. Ad esempio, per distinguere le alterazioni emotive dai problemi di salute reali sono necessarie nuove strategie e tecnologie per l'analisi collettiva e non strutturata degli ECG provenienti da gruppi di soggetti che condividono un'esperienza comune. Questo è un aspetto che non abbiamo trovato in letteratura ed è uno degli obiettivi principali del progetto. Sebbene l'ECG sia molto studiato, non ci sono molti articoli in letteratura dedicati alla compressione dell'ECG, probabilmente perché le dimensioni dei dati delle registrazioni ECG sono relativamente piccole. Le cose cambiano, tuttavia, se si vuole effettuare l'acquisizione 24 ore su 24, 7 giorni su 7, con dispositivi indossabili, l'acquisizione di grandi folle di persone per l'analisi delle emozioni o l'archiviazione delle cartelle cliniche cartacee degli ospedali in formato digitale. Da un'indagine della letteratura sulla compressione dell'ECG non sono emersi molti risultati, per lo più indagini sull'elaborazione dell'ECG in generale che descrivono solo tecniche generiche. L'enorme quantità di dati prevista dallo scenario di questo progetto induce una forte necessità di algoritmi di compressione...
ECG specializzati, innovativi e fuori dagli schemi, che rappresentino la nuova eccellenza nel campo dell'analisi, dell'archiviazione e dell'elaborazione dei Big Data.

Obiettivi

Il progetto PRIN si propone di esplorare nuovi punti di vista sfruttando il monitoraggio ECG per una valutazione più ampia dei parametri di benessere legati alla salute.

- Il progetto si occuperà della varietà di fonti di misurazioni ECG, che possono spaziare da sensori indossabili, come smart-watches o smart t-shirt, a stampanti e archivi fisici cartacei ampiamente adottati nelle applicazioni cliniche.

- Verranno studiate procedure per la compressione dell'ECG a basso costo e basate su modelli, con l'obiettivo di consentire l'acquisizione/trasmissione dell'ECG con dispositivi a bassa potenza e di rendere più efficiente l'archiviazione, tenendo conto anche dell'applicazione innovativa dell'AI/ML. L'uso di tecniche basate su modelli potrebbe essere utile anche per l'analisi e l'interpretazione dell'ECG utilizzando AI/ML.

- Verrà studiata la relazione dell'ECG con lo stress e gli stati emotivi, sia a livello individuale che collettivo.

I risultati di questo progetto contribuiranno a una migliore comprensione di alcuni aspetti ancora inesplorati dell'ECG, quali: la modellazione del rapporto tra ECG e stati emotivi, l'ECG collettivo, i modelli basati su mesh per la generazione di ECG, l'analisi e la compressione basate su modelli. Questi progressi indurranno a loro volta innovazioni nell'assistenza sanitaria e nel monitoraggio, nella gestione dello stress e nell'intervento rapido in caso di necessità. Ciò avrà un impatto positivo sulla salute pubblica e anche sull'economia, grazie alla creazione di nuovi dispositivi e servizi legati all'ECG e, di conseguenza, di nuovi posti di lavoro.

Text in English:

ECG is one of the most common diagnostic tools. Deep learning methods have achieved promising results on predictive healthcare using ECG signals. A publication trend exponentially growing in the last years presents different deep learning architectures that have been used in various ECG analytics tasks, such as disease detection/classification, annotation/localization, sleep staging, biometric identification, and denoising. Two of the most promising interdisciplinary frontiers in this field are 1) Safe driving intensity and cardiac reaction time assessment and 2) Emotion detection. Full exploitation of ECG information in the wider context of individual and social wellbeing is still in its infancy. The availability of devices capable to collect physiological signals is opening the possibility for the new data collection and interpretation scenarios that will be addressed in this PRIN project. For example, disentangling emotional alteration from real health issues requires new strategies and technologies towards collective and unstructured analysis of ECGs coming from groups of subjects sharing a common experience. This is something that we did not find in literature and is one of the main focus of the project.

Although ECG is very well-studied, there are not many articles in the literature devoted to ECG compression, probably because ECG recordings data size is relatively small. This, however, changes if one aims to do 24/7 acquisition with wearable devices, acquisition of large crowds of people for emotional analysis, or store the paper records of hospitals in digital form. A survey of the literature about ECG compression did not turn out many results, mostly surveys about ECG processing in general describing only generic techniques. There huge data size expected by the scenario of this project induces is a strong need for some specialized, innovative and out-of-the-box ECG compression algorithms that will represent the new excellence in the field of Big Data analysis, storage and processing.
Goals

The PRIN project aims to explore novel point of views exploiting the ECG monitoring for a wider evaluation of for health-related wellbeing parameters.
- The project will address the variety of sources of ECG measurements, that may range from wearable sensors, such as smart-watches or smart t-shirt, to printers and physical paper archives widely adopted in clinical applications.
- Procedures for low-cost, model-based ECG compressions will be investigated, with the aim of allowing ECG acquisition/transmission with low power devices and making storage more efficient, taking in view also AI/ML innovative application. The use of model-based technique could be useful also for ECG analysis and interpretation using AI/ML.
- The relation of ECG with stress and emotional states will be investigated, both at an individual and collective level.

The outcomes of this project will contribute in a better understanding of some still unexplored aspect of ECG such as: modelling the relationship between ECG and emotional states, collective ECG, mesh-based models for ECG generation, model-based analysis and compression. Those advancements will in turn induce innovations in health care and monitoring, stress management and rapid intervention when needed. This will have a positive impact on public health and also on the economy, thanks to the creation of new devices and services related to ECG and, consequently, new jobs.

Struttura dell'Università di Udine presso la quale verrà sviluppata l'attività di ricerca / Department or other structure of the University of Udine where research activities will be carried out:

Dipartimento Politecnico di Ingegneria e Architettura (DPIA) / Polytechnic Department of Engineering and Architecture

Importo dell'assegno di ricerca (al lordo oneri carico assegnista) / Total grant gross for the research fellowship:

€ 25.941,33

Durata dell'assegno di ricerca / Duration of the research fellowship “assegno di ricerca”:

16 mesi / months

Finanziamento / Financed by:


Requisiti di ammissione / Minimum qualifications necessary:

- Possesso di un diploma di laurea vecchio ordinamento (ante decreto 3 novembre 1999 n. 509) o di laurea specialistica/magistrale (ex decreto 3 novembre 1999 n. 509 e decreto 22 ottobre 2004 n. 270) o titolo equivalente conseguito all’estero;
- possesso di un curriculum scientifico professionale idoneo allo svolgimento dell’attività di ricerca contemplata.

RESEARCH SERVICES AREA
Research Training Office
Department Head: Sandra Salvador
Procedure Supervisor: Sandra Salvador
Procedure Compiler: Francesca Mion
- University degree obtained before Decree n. 509 of 3 November 1999 or specialistic/Master’s degree (post decree n. 509 of 3 November 1999 and decree n. 270 of 22 October 2004) or equivalent degree obtained abroad;
- professional scientific curriculum suitable for the research activity above mentioned.

**Procedura selettiva / Competition procedure:**

Valutazione per soli titoli / Assessment of qualifications only

**Commissione giudicatrice / Examining Board:**

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<td>Riccardo Bernardini</td>
<td>PA</td>
<td>ING-INF/03</td>
<td>Università degli Studi di Udine</td>
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<td>Roberto Rinaldo</td>
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<td>Sara Ceschia</td>
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<td>PO</td>
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