



PhD in DESIGN - 39th cycle

PNRR 118 PNRR Research Field: BRIDGING COMPUTATIONAL DESIGN TO SUSTAINABILITY THE CONTRIBUTION OF GENERATIVE AND RESPONSIVE TECHNOLOGIES IN THE DEVELOPMENT OF ADAPTIVE BIOPHILIC ENVIRONMENTS

Monthly net income of PhDscholarship (max 36 months)

€ 1195.5

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

Motivation and objectives of the research in this field

Over the last decade, design has increasingly taken advantage of the growing availability of digital technologies. More recently the design interpretation of data from real-time sources allows the development of scenarios where the variability is integrated both in the dynamics of the simulation and in the adaptive capacity of the physical systems of living spaces, leading to unprecedented feedbacks in design research and practice. Therefore, the opportunity derived from this field of design research is mainly due to the enabling possibilities of technologies to interact with context: data can encode information and become a source to simulate behaviours, prefiguring and performing adaptive outcomes. In the meantime, visions focusing on the relation between people, artifacts and nature, such as Posthumanism and Biophilic design, are emerging. While Posthumanism drives towards the integration of human centered design with the interests of non-humans (van Dijk, 2020), Biophilic design is understood as the ability to “incorporate natural features and systems into the built environment” (Kellert, 2018). The research is motivated by the ongoing digital transformation in interplay with increasing ecological and social sustainability needs. The relationship between environment and design is thus not limited to energy and/or resources management but draws forms of an artificial ecology (bio-digital integrated systems) as an expression of a new alliance between design and nature. The objective is to explore the potential of adopting design approaches



	is to explore the potential of adopting design approaches emerging from such synergy to explore the contributions that responsive and computational technologies can give to support the sustainable development of adaptive environments. The research is expected to develop strategies and operational guidelines useful in defining the principles of Biophilic Design in the design processes of responsive and living artifacts, as well as the construct of a new framework for the more extensive development and application of the algorithmic approach in the design process. The research theme arises at the intersection of PNRR Missions “digitalization and innovation” (M1) and “ecological transition” (M2). So, the submission of research proposals based on interdisciplinarity between the fields of representation, interaction design and built environment is encouraged. Giaccardi, E. & J. Redström (2020), “Technology and More-Than-Human Design”, in <i>Design Issues</i>: 36-4, MIT. Kellert, S.R. (2018), <i>Nature by Design: The Practice of Biophilic Design</i>, New Haven, Yale University Press. Nebuloni, A. et al. (2019), “Computational approaches in design”, in <i>Proceedings of the 3rd MDA Conference</i>, Marsala. Speed, C. & Oberlander, J. (2016), “Designing from, with and by Data”, in Lloyd, P., Bohemia, E. (ed by.), <i>Proceedings of DRS2016</i>, Brighton. Van Dijk, J. (2020), “Post-Human Interaction Design”, in <i>DIS 2020</i>, Companion.
Methods and techniques that will be developed and used to carry out the research	The research will interweave theoretical-conceptual phases (from literature research to quantitative studies) and applicative-experimental ones (analysis and qualitative studies). Users will be involved at all stages of the research process, and prototypes will be used to “allow the design process to proceed and the intended outcome to be anticipated” (Giaccardi & Redström, 2020). Literature review related to the topics of research needs to be first analysed and then framed to provide an overview of technologies, as well as understand the current status and direction of development. Framing and bridging of knowledge, mainly regarding the concepts of Biophilic Design, Computational Design and the



	Embodied Interaction, the aim of this phase is to establish the theoretical background of the research. Theoretical-conceptual phases will also include: - the investigation of existing design frameworks that intertwine environmental aspects with Computational Design and Design by Data approaches. - the development of methods of a computational nature, where data can regard user preferences/behaviors and environmental parameters acquired through observation, digital ethnography (e.g. text or image analysis) or bio- and environmental sensors. In this first step, technical information outputs and user needs are relevant to improve the feasibility and purpose of the research. The applicative-experimental phases will be organized in: - develop computational models to simulate natural processes, forms and structures to support the investigated theme. - making responsive artifacts, living artifacts and demonstrators by applying the developed models. - evaluate the effectiveness of the proposed artifacts in terms of well-being, engagement, and human/artefact/environment interaction. Feedback and data derived from the applicative-experimental phase will be evaluated to optimize and iterate the biophilic design method via computation.
Educational objectives	The proposal aims to educate designers who will contribute original knowledge to the development of the interdisciplinary field of interaction design (mainly Embodied Interaction design, Posthuman and More-Than Human Centred Design) and sustainable transition, taking advantage of computational design tools. More specifically, candidates will be able to address emerging questions in design practice and research, such as: • How can bio-digital integrated systems support biodiversity and interaction at individual and community level? • How can parametric codes and data address this challenge? • How can social, technological, and environmental issues



	be integrated into sustainable development through computational design? Therefore, the three main educational objectives that the research aims to achieve are: •develop a bio-digitalintegrated design beyond models of biomimetics and towards new paradigms of responsive, adaptive and biophilic design. •lead the strategy and implementation for computational design solutions, environmental data-driven management and digital fabrication for new green transition in (mainly) space design and built environment adaptations. •integrate computational thinking as part of co-design methodologies and solutions aimed at social and environmental changes. During the PhD program, the candidate will have the opportunity to attend courses and seminars on design research, dealing with different research tools and methods best suited to the development the research issue and activity. In addition, the research and training period abroad at Department of Experimental and Digital Design and Construction (University of Kassel)will give candidates the possibility to implement knowledge and contribute to strengthen their capacity to work interdisciplinarily in research groups and co-design teams – especially with data analyst and artificial intelligence experts.
Job opportunities	An increasing number of research agencies are looking for experts in data infrastructure and science, data-enabled innovation, and interaction design approaches. Looking at the real-time information derived from new technologies and sensors spread in our space, data drive not only performance changes, but firstly the design choices, changing knowledge and practices of design itself. The challenge for designers is, therefore, to connect this large volume and variety of data, discovering patterns (also learning from behaviors), processing them and finally generate new kinds of living spaces, as well as services and benefits for users and environment. The research is at the cross between the two major issues of digital transition and sustainability, facing an area of new



	specific competencies and skills. In addition to the possibility of developing research in academia, job opportunities are foreseen in different companies, research and institutional organizations, as well as research centers, international consulting, sustainability and climate/energy design teams, mainly in the following positions: •Research Scientist, •Research project manager, •Environmental Scientist. •Senior Computational designer, •Sustainability analyst/specialist, •Associate Sustainability consultant, •Social Impact and Sustainability Expert, •Customer Experience and Design Specialist, •Green Tech Process Innovator. •Service designer AI applications, •Innovation ecosystem expert.
Composition of the research group	1 Full Professors 1 Associated Professors 2 Assistant Professors 1 PhD Students
Name of the research directors	Fiammetta Costa; Attilio Nebuloni

Contacts
email: fiammetta.costa@polimi.it email: attilio.nebuloni@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.75 €
By number of months	6

National Operational Program for Research and Innovation



Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	University of Kassel Department of Experimental and Digital Design and Construction
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences):

financial aid per PhD student per year

max 4.872,90 euros per student (total for 3 years)

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student there are various forms of financial aid both for research and teaching activities. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer availability: 1st year, 2nd year and 3rd year: Each research group will supply PhD student with a computer, if necessary.

Desk availability: 1st year, 2nd year and 3rd year: Each research group will supply phd student with a desk.