Call for Two Early Stage Researchers positions as PhD scholarships available at the Università degli Studi di Milano (ITALY), in the framework of the EU-funded Marie Skłodowska - Curie ITN-EID training network “BIGMATH- Big Data Challenges for Mathematics”

The BIGMATH Network

BIGMATH is an Innovative Training Network programme for highly motivated young scientists, where state-of-the-art research is combined with a comprehensive training programme. The network is funded by the European Community through the Horizon 2020 MSCA-ITN-EID Actions. The European Commission wants to make research careers more attractive to young people and therefore offers early-stage researchers (ESRs) the opportunity to improve their research skills, join established research teams, and enhance their career prospects via the so-called Marie Curie Initial Training Networks.

The scientific goal of BIGMATH is to address the major challenges that the Big Data era is posing to mathematical research, in particular in the areas of optimization, statistics, and large-scale linear algebra.

The ESRs will be trained both on cutting-edge research on targeted mathematical disciplines, and on a wide set of “soft skills” that will enable them to transfer effectively their knowledge to the productive world, thus fostering the European market to create innovation.

These abilities will result from a close partnership between academy, providing the students with up-to-date training and scientific knowledge on targeted mathematical disciplines, and a group of industries, who will complete the competences of the ESRs by exposing them to a set of Big Data-related real industrial problems.

The BIGMATH network consists of 4 universities and of 7 industrial partners located in Italy, Portugal, The Netherlands, Serbia.

For more information on BIGMATH, please visit the web site http://itn-bigmath.unimi.it/.

The research projects

**Project A title: Mathematical morphology for the prediction of face expression (ESR2)**

The objective of this project is to provide a realistic mathematical description of human face expression transition, for virtual reality applications. Human face expressions can be classified into about 60 different classes, but the transition from one class to another must be sufficiently “smooth” to avoid producing motion and perception artefacts. Actually a linear interpolation between the geometrical descriptions of the different classes in many cases is not sufficiently realistic. Thus the goal of the student enrolled in this project will be to develop and apply **new stochastic geometric techniques, nonlinear regressions and non linear optimization techniques** to the 4D data scanned from real human face expression, to model correctly the transition of the space-time distributions of the landmarks or
surfaces describing the expression. The developed models will take into account both the possible imbalance in the sampling of face expressions and the real-time computability requirements of the company, and will thus be reduced to fasten the computation, and optimized in a distributed manner.

**Planned secondments for Project A:**
- 18 months to 3Lateral (Novi Sad - Serbia), a company producing virtual reality applications for videogames, movies and entertainment. This secondment will be splitted into a first period of 5 months at the beginning of the PhD program, to get a deep understanding of the problems to be solved, and get used with the data format, and a second period of 13 months at the end of 2nd and 3rd year of the program, to develop the industrial project related research.
- 2 months at University of Novi Sad (Serbia), immediately before the second period of secondments to 3Lateral, for specific training on distributed optimization techniques.

**Project B title:** Stochastic Geometric modelling and 3D image analysis for human face prostheses (ESR3)

Extracting usable parametric geometry models from point data is an open challenge. Assuming a set of point clouds obtained from instances of an (unknown) parametric class of 3D objects, the challenge is to recover, by developing suitable statistical methods on manifolds or in non Euclidean spaces, the underlying parametric surface model, knowing that point clouds are corrupted with noise, missing data, outliers and are non-uniformly sampled with different densities. Prior work, describing human lower legs, was capable of achieving the required objectives with a dataset consisting of a hundred human scans. In this project, surface models with high intrinsic curvature will be considered, requiring both different modelling techniques and the creation of much larger real-world datasets. Registration of these datasets in a common reference frame, prior to model extraction, is a common pre-processing operation, consisting of identifying shared features, which can be pre-aligned. The industrial goal for this student will be to recover models of human face features (e.g. ears, noses) for the prosthetic industry, which require high quality colour models. In this setting, model instantiation is constrained by the border conditions of the existing face shape and texture to which the generated model will need to fit.

**Planned secondments for Project B:**
- 18 months to µRoboptics (Lisbon - Portugal), a company working on robotics, computer vision, engineering solutions and medical technological devices. This secondment will be splitted into a first period of 5 months at the beginning of the PhD program, to get a deep understanding of the problems to be solved, and get used with the data format and acquisition, and a second period of 13 months at the end of 2nd and 3rd year of the program, to develop the industrial project related research.
- 2 months at IST Lisbon University (Portugal), immediately before the second period of secondments to µRoboptics, for specific training on network theory, optimization and noise reduction.

**Starting date and duration of both projects:** 3 years starting from March 1, 2019.
Research Group and General Conditions

The recruited PhD students will perform their activity under the supervision of prof. Alessandra Micheletti, at the Department of Environmental Science and Policy, University of Milan, ITALY. The recruited PhD students will be enrolled in the PhD programme in “Mathematical Sciences”, and will be covered under the social security scheme. They will receive a Monthly Living Allowance plus a Mobility Allowance compliant with the applicable EU Marie Skłodowska-Curie Actions-ITN general conditions.

The recruited PhD students will participate in the network’s training activities and work placements at the schools and laboratories of the participating academic and industrial partners. In addition, the training programme of the recruited ESRs will be supplemented by regular meetings and workshops within the BIGMATH International Training Network.

Admission criteria for doctoral education at University of Milan

In order to apply for a position in the PhD programme, students must have a second-level degree, an equivalent qualification, or an equivalent qualification by study level (Master of Science Degree) from a foreign University. The suitability of the foreign academic qualifications in terms of content is appraised by the Examining Board constituted for admission to each PhD programme, in compliance with the regulations in force in Italy and in the country in which the academic qualification was issued, and the international treaties or agreements pertaining to the conferment of qualifications for the continuation of studies.

ESRs shall, at the time of recruitment, be in the first four years (full-time equivalent research experience) of their research careers and have not been awarded a doctoral degree. Full-time equivalent research experience is measured from the date when the researcher obtained the degree entitling him or her to embark on a doctorate, (either in the country in which the degree was obtained or in the country in which the researcher is recruited) even if a doctorate was never started or envisaged. Part-time research experience will be counted pro-rata.

Other project specific requirements

- The Candidates must preferably hold a M.Sc. Degree by the starting date of the fellowship, in one of the following areas: Mathematics, Computer Science, Engineering, Physics, Statistics.
- The contract will last 36 months.
- Salary and additional benefits are according to EU-standards for Marie Curie ESRs. Additional benefits are foreseen for mobility and family allowance (if applicable).
- The ESR must be working exclusively for the action.
- Each ESR will have to complete at least 18 months of secondments to an industrial partner.
- Each ESR must actively participate in the events organized by Universities and Industrial partners, such as training/network events as well as in regular yearly Outreach Activities targeting different audiences.
- Recruitment, selection and appointment of the ESR follow the European Charter & Code of Conduct. All BIGMATH partners commit themselves to provide equal opportunities for
male, female and disabled ESRs.

- ESRs’ progress will be regularly monitored. Every year, the candidates and their work will be challenged and questioned. Failure in providing evidence of a regular and continuous commitment may result in the exclusion from the programme.
- Good collaborative and social skills and an open-minded attitude.
- Proficiency in the English language (minimum level: B2)

**Mobility eligibility requirement**

Eligible ESRs candidates may be of any nationality but must not, at the time of recruitment, have resided or carried out their main activity (work, studies, etc.) in Italy for more than 12 months in the last 3 years immediately prior to the recruitment date.

**Application procedure**

List of Documents to provide:
- Application Form (see attachment)
- Letter of motivation (max. 1 page)
- Copies of degree and academic transcripts (with grades and rankings)
- Resumé of Master’s thesis (max. 3 pages)
- Short CV including a publication list (if any)
- Two reference letters from academics, prepared according to the attached template. The letters can be sent directly by the academics, but candidates must indicate the academics’ details when applying
- Passport copy
- English proficiency certificate (optional. It must be presented by the candidate, if selected, before the enrolment)

All the above-mentioned documents must be collected in pdf files, preferably in a unique file. The pdf file(s) have to be sent, in a single email, within December 31, 2018 to the BIGMATH Coordination Office at the following email address: bigmath@unimi.it

**Recruitment strategy**

A common scoring system and interviews of the candidates will be used, respecting privacy and protection of the Applicant’s data. Female candidates and candidates with disabilities are encouraged to apply.

The selection process is based on two steps:
1. Evaluation of the documents provided by the Applicant (Assessment of academic records) and preselection of up to 6 candidates
2. A modelling or data analysis problem will then be submitted to the candidates passing phase 1, and they will be requested to present their results one week later, during an interview by the selection committee, which will be organized remotely, via teleconference.

The selection committee will be composed by representatives from University of Milan, IST Lisbon, University of Novi Sad, 3Lateral, µRoboptics.

The first phase (preselection) will be concluded and the results will be notified to the candidates
by email by January 13, 2019.
The modelling problems will be assigned by email on January 14, 2019 and the interviews will take
place on January 21, 2019.

For any further inquiry or information, please write to: bigmath@unimi.it