



**Application form**

**Call #2 deadline: October 14th 2022**

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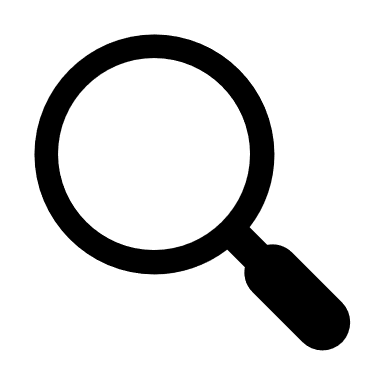
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V1.0

**GUIDELINES**

The application should be completed in English and submitted along with the mandatory supporting documents. All sections of the form should be completed. If not relevant, please enter « N/A » in the appropriate field.

The documents must be uploaded separately (as indicated on the platform). It is limited to 10 MO per document.

Documents to be included in your application:

1. Filled application form (fully dated and signed) – **1 PDF document** (part 1, from pages 4 to 9, ensure that the signature appears on the right page)
2. Research project (**max 10 pages from part 2.2**)
3. CV & track record (**max 5 pages from part 2.3**) **1 PDF document** (part 2, from pages 11
4. Ethics self-assessment to 18) **max 22 pages**
5. ID (a copy of the identity proof, like valid passport) – **1 PDF document**
6. Phd or Phd letter of committment(a letter in English from the PhD delivering University to attest the near future delivery of the PhD) or work certificates (if no PhD degree at all) to justify at least 4 years of full-time research experience. For the PhD degree / work certificate(s), a copy of the original and non-certified English-translated copies are needed (certified translations will be requested in case the applicant is selected) – **1 PDF document**
7. Recommendation letters (2) – **2 PDF documents**
8. Other documents: if applicable – **1 PDF document**

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**All documents must be named as follows:**

* **“ProjectAcronym\_NameApplicant\_TypeofDocument”**

For any question, refer to the Guide for Applicants and the FAQ on the website <https://www.normandie.fr/winningnormandy-fellowship-programme> or please contact the following email address [winning@normandie.fr](mailto:winning@normandie.fr)

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**Please do not modify the template of the form for the submission and keep the frame. All applications without the requested template will be rejected**

# APPLICATION FORM (to be uploaded separately from part 2)

## Applicant administrative data

|  |  |
| --- | --- |
| Name | Assunção de Almeida |
| First name | Lucas |
| Place of birth (city, country) | Fortaleza, Brazil |
| Date of birth | April 18th, 1988 |
| Sex | Male |
| Nationality | Brazilian |
| Nationality 2 | N/A |
| Home address | Rua doutora Socorro Azevedo, 140, apto 103. Fortaleza, Ceará, Brazil. ZIP code: 60810-400 |
| Current place of residence | Fortaleza, Brazil |
| Current organisation name | Arcelormittal |
| Home telephone | +5585996338699 |
| Work Mobile telephone | N/A |
| E-mail address | lucas.suncao88@gmail.com |
| ORCID-ID (or Researher ID) | 0000-0002-7039-6368 |
| Country in which PhD or equivalent awarded | Brazil |
| Date PhD awarded (or to be awarded) | 19/08/2019 |
| Proposed starting date for the 24-month fellowship (possible between April, 1st, 2023 and October, 1st, 2023) | 18/04/2023 |
| I would like to apply for MSCA Special Needs Allowance \* | No |
| How did you find about the call? | through my ex-advisor from Masters. |

*\*Supplementary* ***MSCA Special Needs Allowance*** *(max 60,000 € per researcher) can be asked by the fellows for who the long-term physical, mental, intellectual or sensory impairments are as such that their participation in WINNINGNormandy would not be possible without extra financial support. This grant will cover the additional mobility costs, e.g. to ensure necessary assistance by third persons or for adapting the researchers’ work environment (social security and health insurance will be covered by other means).*

Please explain if applicable:

|  |
| --- |
| N/A |

## Place of activity / place of residence

Indicate the period(s) and the country/countries in which you have legally resided and/or carried out your main activity (work, status, ...) **during the** **last 3 years up until the call deadline (October, 14th, 2022)**. Please fill in this section by adding as many lines as necessary without gaps and by putting the most recent one first.

In compliance with the Marie Sklodowska-Curie mobility rule, **candidate must not have resided or carried out his/her main activity (work, studies, etc.) in France for more than 12 months in the last three years before the call deadline (October, 14th, 2022)”.**

|  |  |  |
| --- | --- | --- |
| **Period from (DD/MM/YYY)** | **Period to (DD/MM/YYY)** | **Country** |
| 14/10/2019 | 14/10/2022 | Brazil |

## Calculation of the total full-time postgraduate research experience

**The following table is only to be filled out if the applicant does not have a PhD degree at call deadline:**

Researchers without a PhD degree at the call deadline should clearly justify at least four years of full-time equivalent research experience in the table below. It is also essential that the CV clearly points out these research experiences and explains how it is calculated in the template below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Academic qualifications counting towards the total full-time postgraduate research experience** | | | |
| University degree giving access to PhD[[1]](#footnote-1): | Institution name and country | Date of award (a) |  |
|  | DD/MM/YYYY |
| Other university degree(s)/master(s), if any, obtained after the award of the university degree giving access to PhD: | Institution name and country | From | To |
|  | DD/MM/YYYY | DD/MM/YYYY |
| Full time research experience | Proportion of research activities as a percentage of the duration of the Master | Duration of research activities expressed in months |
| xx % | (b)[[2]](#footnote-2) = xx% \* duration of Master |
| PhD: | Institution name and country | From | To (Date of expected Award) |
|  | DD/MM/YYYY | DD/MM/YYYY |
| Full time research experience[[3]](#footnote-3) |  | Duration of research activities expressed in months |
| (c) |
| **Other research activities counting towards the total full-time postgraduate research experience** | | | |
| Position: | Institution name and country | From | To |
|  | DD/MM/YYYY | DD/MM/YYYY |
|  | Full time research experience |  | Duration of research activities expressed in months |
| (d) |
| **Total full-time postgraduate research experience: number of months** | | | **= (b)+(c)+(d)** |

## Host research unit

Based on individual-driven mobility, applicants will freely choose a research topic and the appropriate host (and secondment) organisation(s) and supervisor(s) fitting their scientific interest. It will be up to the applicants to search and contact the most suitable research unit (and secondment organisation(s)) and supervisor(s)) to discuss a potential cooperation and the research project.

Contact details of host institutions and laboratories are available on the WINNINGNormandy portal: <https://www.normandie.fr/winningnormandy-fellowship-programme> in the section “List of Norman Research Units”



### Future host research unit

|  |  |
| --- | --- |
| Name of the research unit | LITIS - Laboratoire d'Informatiques, de  Traitement de l'Information et des Systèmes.  Université Le Havre Normandie |
| Address | 25, rue Philippe Lebon, 76600, Le Havre |
| E-mail address | laurent.heutte@univ-rouen.fr |
| Telephone | 02 32 95 50 11 |
| I have established a contact with the host research unit | Yes (mandatory) |

### Future supervisor

|  |  |
| --- | --- |
| Name | Cynthia Santos |
| First name | Andréa |
| Position (director, researcher, etc.) | Full Professor in Computer Science,  Research Director of the Institut Supérieur  d’Études Logistiques (ISEL),  Vice President of the digital transformation. |
| Title (Prof., Dr., Mr., Mrs.,…) | Dr. |
| Address | 25 rue Philippe Lebon, 76600, Le Havre |
| E-mail address | andrea-cynthia.duhamel@univ-lehavre.fr |
| Telephone | 07 60 46 78 06 |
| I have established a contact with the future supervisor | Yes (mandatory) |
| Additional information | N/A |

### Future host organisation for secondment (if applicable)

Secondments (intersectoral, international or interdisciplinary) consist typically of a short research stay (**up to 3 months over the 2-year fellowship**) in the premises of the host for secondment. Please notice that the secondments are taken into account in the evaluation criteria[[4]](#footnote-4)*.*

**Please duplicate the table in case of more than one secondment envisaged.**

|  |  |
| --- | --- |
| Name of the organisation |  |
| Department/ research unit / industry |  |
| Address |  |
| E-mail address |  |
| Telephone |  |
| I have established a contact with the future host organisation for secondment | Yes/No. Please indicate if the secondment is confirmed or not (yet). |
| I have not contacted the future host organisation for secondment but would like to benefit from this possibility | Yes/No/NA. If Yes, please motivate your demand in the description of your research project |
| **My contact at the organisation for secondment** | |
| Position (director, researcher, etc.) |  |
| Title (Prof., Dr., Mr., Mrs.,) |  |
| Name |  |
| First name |  |
| E-mail address |  |
| Telephone |  |
| Additional information |  |

### Mentoring

Mentoring is a one-to-one relationship between a mentor and a mentee, and is highly important to develop as an independent researcher. In addition to a supervisor, each fellow will benefit from a mentor from the extra-academic sector to ensure intersectoral supervision (or from academic sector if interdisciplinary or international project).

|  |  |
| --- | --- |
| **Future mentor (if already identified in collaboration with the host supervisor)** | |
| Name of the organisation |  |
| Position (director, researcher, etc.) |  |
| Title (Prof., Dr., Mr., Mrs.,..) |  |
| Name |  |
| First name |  |
| E-mail address |  |
| Telephone |  |
| Additional information |  |

## Declarations

I, Lucas Assunção de Almeida, consent to the following processing, use and sharing of my personal data by the Région Normandie:

For the purposes of reviewing and evaluating the project proposal by international external experts, specialized library staff, and WINNINGNormandy project management team to determine eligibility and funding decisions related to the WINNINGNormandy programme.

For reporting purposes to the European Commission or other public bodies, specifically in the EU portal, the WINNINGNormandy website, annual reports, project updates and financial reports.

For data processing regarding the financial management of the WN programme.

For communication purposes regarding the WN programme and its activities.

I am aware of my rights under the GDPR and in particular that my consent is voluntary and can be withdrawn at any time. These rights may be exercised at [dpo@normandie.fr](mailto:dpo@normandie.fr)

A full GDPR Summary concerning the Regional Council is available on:

<https://www.normandie.fr/protection-des-donnees-caractere-personnel>

I declare that *“in compliance with the Marie Sklodowska-Curie mobility rule, I have not / will not have resided or carried out my main activity (work, studies, etc.) in France for more than 12 months in the last three years before the call deadline (October, 14th, 2022)”.*

I declare that *“I am / will be in possession of a doctoral degree[[5]](#footnote-5) or have at least four years of full-time equivalent research experience (as detailed in Table 1.2) at the date of the recruitment”.*

I declare that *“I have read the Application Guide / Frequently Asked Questions of the programme, and the references therein, and understand and agree on the requirements, obligations and conditions inherent to the fellowship programme financed by the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions”.* These requirements, obligations and conditions for example concern (non-exhaustive list) the mandatory training events, Open Access to scientific publications and research data, fundamental principles of Ethics and Research Integrity, declaration of any conflict of interest…

I declare that *“the information that I have given on this Application Form is complete and accurate”*.

I declare that, *“except as otherwise stated on this form, I have not started the project which forms the basis of this application and no expenditure has been committed or defrayed on it”.*

First Name, Name : Lucas, Assunção de Almeida

Date: October 14th, 2022

Signature:

**RESEARCH PROJECT, CV AND ETHICS (1 pdf file, max 22 pages)**

1. Research project **(max 10 pages from part 2.2)**
2. CV & track record **(max 5 pages from part 2.3)**
3. Ethics self-assessment

Any question : [winning@normandie.fr](mailto:winning@normandie.fr)

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**Please do not modify the template of the following form for the submission and keep the frame. All applications without the requested template will be rejected**



# RESEARCH PROJECT (to be uploaded separately from part 1, max 22 pages)

|  |  |
| --- | --- |
|  | **Description** |
| Project Title | Humanitarian Optimization through Mat-heuristics and Metaheuristics |
| Project Acronym | HOMM |
| Project Keywords[[6]](#footnote-6) | Control theory, optimisation and operational research; Application of mathematics in industry and society; Discrete mathematics and combinatorics. |
| Project Abstract | Post disaster relief operations and risk management studies have drawn significant attention over the past decade, aiming at increasing resilience in labour and social environments through prevention and systematic response to emergency events. Within this context, Operational Research (OR) and related fields play a key role in devising mathematical methods to assess data, guide decisions and automate processes. In disaster relief and risk management (as in other “real-world” operations), demands, availability of resources and costs may vary according to the circumstances, and the quality of the decisions made is directly impacted by changes in the current scenario. Thus, considering data uncertainty is crucial to devising more accurate and robust solutions. Different approaches can be applied to model problems under uncertain data, such as stochastic programming and Robust Optimization (RO). In the former, uncertainty is modelled through a probabilistic description and is mostly applied whenever the probability law associated with the uncertain data is known in advance. On the other hand, RO has gained particular attention over the last decades due to its power in modelling uncertainty while still applying the tooling of classical/deterministic optimization. In this project, I intend to propose mathematical programming-based heuristics (mat-heuristics) and metaheuristics to address post traumatic relief operations subject to uncertain data and modelled by means of RO. The initial focus is on the planning of rescue and recovery operations to be performed by land (i.e., using land vehicles) in emergencies caused by natural disasters and incidents in industrial sites. Consider that, within a region affected by a disaster, several locations are potentially in need of a rescue shuttle or relief resources (such as food, water, medicine or other supply). Two chained operations will be addressed in this study: (i) deciding where to place tents for temporary shelter, first aid or supply, taking into account limitations in resources for building/supplying these tents and (ii) devising rescue/supply routes --- using land vehicles --- for visiting these tents and other selected locations where there might be victims. Here, I intend to depict these real-world situations mathematically through RO versions of two classical optimization problems, namely the Facility Location problem and the Steiner team orienteering problem. The quality and efficiency of the algorithms proposed will be tested on instances built based on real data available in the Emergency Events Database (EM-DAT). |

## Project compliance with Normandy Smart Specialisation Strategy (S3)

**For complete list of Normandy S3 objectives, domains and axis, please refer to the Guide of Applicant.**

|  |  |
| --- | --- |
|  | **Description** |
| Smart Specialisation Strategy Domains | Please indicate one or several S3 domains your application complies with:   * Preserving and sustainably transforming agricultural, marine, forestry and production systems; * Develop an energy mix towards zero carbon emissions; * Transforming processes for a high-performance, sustainable and digital industry; * Develop low-carbon mobility solutions that are efficient and secure; * Accelerating synergies and innovation in the service of human and animal 5P medicine; * **Make Normandy a resilient territory by mastering technological, natural, health and social risks.** |
| Axis | Improve risk prevention, control practices & tools in a region highly subject to natural, technological, health and social risks |
| Does your proposal include the transversal domain on digital? | Yes |

## Description of the research project

Please provide a **max 10-page description** of your research project (incl. references) for a 2-year duration, **following the below template and frame**. This must be written by the applicant using standard police (Arial/Times/Calibri etc., size 11, margins 1.5).

|  |
| --- |
| **1. Excellence of the scientific project (*approx. 4 pages*)** |
| **1.1. General context**  Post disaster relief operations and risk management studies have drawn significant attention over the past decade, aiming at increasing resilience in labor and social environments through prevention and systematic response to emergency events [6,13, 26]. Within this context, Operational Research (OR) plays a key role in devising mathematical methods to assess data, guide decisions and automate processes. In disaster relief and risk management (as in other “real-world” operations), demands, availability of resources and costs may vary according to the circumstances, and the quality of the decisions made is directly impacted by changes in the current scenario. Thus, considering data uncertainty is crucial to devising more accurate and robust solutions.  Different approaches can be applied to model problems under uncertain data, such as stochastic programming and Robust Optimization (RO). In the former, uncertainty is modelled through a probabilistic description and is mostly applied whenever the probability law associated with the uncertain data is known in advance. On the other hand, RO has gained particular attention over the last decades due to its power in modelling uncertainty while still applying the tooling of classical/deterministic optimization. In RO, the variability of the data is represented by deterministic values in the context of scenarios. Considering that each parameter subject to uncertainty can be linked to either a discrete set (discrete scenarios model) or a continuous interval (interval data model) of possible values, a scenario corresponds to a parameter assignment, i.e., a value is fixed for each parameter subject to uncertainty. In both cases, a classical (i.e., parameters known in advance) optimization problem takes place whenever a scenario is established. The most commonly adopted RO criteria are the absolute robustness criterion and the min-max regret. The absolute robustness criterion is based on the anticipation of the worst possible conditions. Solutions for RO problems under such criterion tend to be conservative, as they optimize only a worst-case scenario. Intuitively speaking, the regret of a solution in a given scenario is the difference between the cost of such solution and the cost of an optimal one in that scenario. In this sense, the min-max regret criterion aims at minimizing (among all feasible solutions) the maximum (among all possible scenarios) regret.  In this project, I intend to propose mathematical programming-based heuristics (mat-heuristics) and metaheuristics to address post traumatic relief operations subject to uncertain data and modelled by means of RO’s min-max regret criterion. The focus is on the planning of rescue and recovery operations in emergencies caused by natural disasters and incidents in industrial sites. Consider that, within a region affected by a disaster, several locations are potentially in need of a rescue shuttle or relief resources (such as food, water, medicine or other supply). Considering the scenario depicted above, two chained operations will be addressed in this study: (i) deciding where to place tents for temporary shelter, first aid or supply, taking into account limitations in resources for building/supplying these tents and (ii) devising rescue/supply routes — using land vehicles — for visiting these tents and other selected locations where there might be victims. Notice that, also in the second level of the optimization, there might be limited resources (e.g., restricted autonomy of the vehicles, amount of relief resources, etc).  In both levels of the optimization, priority must be given to locations that are more likely to have victims close-by. Accordingly, (uncertain) values of priority/demand can be estimated based on factors as population density or historical data related to similar occurrences (in case of floods or mudslides, for instance) in the region or even by the existence of pre-established points of gathering in case of incidents in industrial sites. Naturally, locations which are known to have victims are given top priority in the first level of the optimization (for building tents close-by) and set as mandatory in the second level (for rescuing/supply routes). The locations chosen in the first level could also be set as mandatory in the second level. To represent these real-world situations mathematically, I intend to apply RO modeling techniques to two classical optimization problems: (i) the Facility Location Problem (FLP) [22] and (ii) the Steiner Team Orienteering Problem (STOP) [3].  FLP is a classical and widely studied NP-hard optimization problem that consists of determining the best sites for factories and warehouses such that given demand points are satisfied. In general, the goal of the problem is to minimize the sum of distances from the selected sites to the demand points or the costs of opening and maintaining the facilities in the selected sites. The facilities may or may not have limited capacities for servicing, which classifies the problems into capacitated and uncapacitated variants. In particular, FLP variations have already been successfully applied to model humanitarian relief operations [23].  On the other hand, STOP belongs to a sub-class of routing problems known as orienteering problems [24]. They are defined on a graph, usually complete and undirected, where a value of priority is associated with each vertex and a traverse time is associated with each edge (or arc). They aim at finding one or more routes (in case of single or multi-vehicle variations) from an origin vertex to a destination one, while satisfying a total traverse time constraint and maximizing the cumulative priorities of the vertices visited. Any vertex/location can only be serviced once and, contrary to the classical traveling salesman problem [11], solutions for orienteering problems do not necessarily visit all the vertices of the graph, but prioritize the ones associated with higher priority values. When some of the vertices to be visited are set as mandatory, the variation of interest in this project (STOP) arises [3, 20]. In STOP, the vertex set is sub-divided into mandatory and optional, being only the later associated with priorities. The goal is to find disjoint routes (one for each vehicle) that, together, maximize the sum of priorities serviced (by visiting optional vertices), while satisfying the routes’ time constraint and necessarily visiting all mandatory vertices.  Currently, STOP finds its main applications in devising the itinerary of the delivery of goods by shipping companies and in the planning of technical visits, where a priority value — which may rely on factors such as the urgency of the request and the customer’s rank/category — is associated with visiting each customer/location, and deliveries/visits with top priority (e.g., those whose deadlines are expiring) are set as mandatory. Quite recently, the potential of orienteering problems for modelling post disaster relief operations was explored for the first time in an application of rescuing victims from industrial sites in Italy during emergency situations [6].  Aside from the several real-world applications linked to STOP, its theoretical complexity also makes it a particularly interesting problem. In addition to being NP-hard, solely finding a feasible solution for an STOP instance (or proving its infeasibility) is NP-hard in the general case [4]. This fact brings and extra layer of difficulty to devise either exact or heuristics methods for the problem, since building initial primal solutions might already be time consuming.  As mentioned above, this project focuses on RO versions of FLP and STOP applied to disaster relief situations, where response speed plays a crucial role, being even more important than the optimality of the plans in some cases. This is particularly challenging when dealing with RO (min-max regret) problems, as solely evaluating the (robust) cost of a solution involves solving an instance of the corresponding classical counterpart. Considering this issue, the aim of this project is to explore efficient ways of generating high quality solutions for both problems though mat-heuristic and metaheuristic frameworks. The goal is to devise algorithms able to give quick responses considering dynamic changes in the input of the problem (e.g., modifications in priority estimations and addition of new vertices/locations to be covered). In this sense, an ideal algorithm should be able to both generate an initial feasible solution and repair/adapt a solution made infeasible due to updates in the input data. |
| **1.2. Originality and Excellence**  Three main aspects of this project make it stand out in terms of scientific contribution and innovation:   * **Pioneering in applying RO techniques to humanitarian optimization:** despite the great attention research in humanitarian relief operations has drawn in the last years, the majority of the works in the field deal with uncertainty through scenarios stochastic programming. Only quite recently the RO’s potential in modeling these situations has started being explored [27]. In this sense, the (possibly positive) results obtained by this project will help support this new trend as a pro-eminent topic of study in humanitarian optimization. Additionally, applying mat-heuristics to RO problems is a research path yet to be explored in the literature; * **Planning disaster relief operations through algorithmic solutions:** using OR approaches to guide rescue and recovery operations after natural disasters (like earthquakes, floods and mudslides) and accidents in industrial sites has gained attention in the past years. Several works, ranging from exact solutions to evolutionary-based meta- heuristics [26] have been published in the topic. A wide range of classical optimization problems have been used to model these operations, especially scheduling, routing and facility location problems [7, 9, 18]. Only quite recently an orienteering problem has been used to model these situations [6]. In that regard, this project is among the first studies that apply the modelling potential of orienteering problems in the context of disaster relief management; * **Solving a challenging optimization problem in terms of theoretical complexity:** as previously mentioned, finding an initial solution for STOP is already NP-hard, which makes it a challenging and interesting problem to be studied, regardless of its applications to risk management and post disaster recovery.   FLP is a classical combinatorial problem with several practical applications, including emergency humanitarian logistical problems [8, 14], and has been studied under a range of different variations of objective function, number of the facilities to locate, uncertain data and the solution space of interest. The problem can be either deterministic (when the number of candidate facilities is finite) or continuous (if the facilities can be placed anywhere in some continuous region), and might also be classified into capacitated (if each location has a limit on satisfying demands) or not. I highlight that, despite the great amount of works dealing with FLP and its variations, a very limited number of them uses RO to model uncertainty. In fact, the use of RO in emergency humanitarian logistics in general is not widespread yet [8]. In this sense, this project is one of the pioneering works to explore this new research trend. For detailed surveys on the classical FLP and its versions under uncertain data, I cite [8, 12].  Although the literature of orienteering problems is vast, both in terms of heuristic and exact methods [16, 17, 19, 25], STOP was introduced quite recently [3], and only few works address the problem. Its single vehicle version, namely the Steiner orienteering problem, was introduced by Letchford et al. [20]. In the work, the authors propose four Integer Linear Programming (ILP) models for the problem, but no computational experiment is reported. STOP was formally introduced only few years later [3], where a state-of-the-art branch-and-cut algorithm from the literature of the Team Orienteering Problem (TOP) was adapted, and a new cutting-plane algorithm proposed. The latter work relies on a compact (with a polynomial number of variables and constraints) commodity-based formulation — also introduced in the work — reinforced by three classes of inequalities. The cutting-plane proposed not only outperforms the baseline when solving a benchmark of STOP instances, but also solves to optimality 14 more TOP instances than any previous algorithm in the literature and finds eight new optimality certificates.  Motivated by the NP-hardness of finding a feasible solution for STOP, a Large Neighborhood Search (LNS) heuristic has been recently proposed for the problem [4]. The heuristic is provided with initial solutions obtained by means of the mat-heuristic framework known as feasibility pump [15], which, in this case, uses as backbone the commodity-based formulation of [3] reinforced by two new families of valid inequalities also introduced in the work. Computational experiments show the time efficiency and effectiveness of the proposed heuristic in solving a benchmark of STOP instances. In particular, the heuristic reaches the best previously known bounds on 382 of the 387 instances and improves over the best known bounds in 21 of these cases.  More recently, motivated by applications related to emergency management in industrial plants in Italy, the multi origins capacitated team orienteering problem was introduced and solved through an ant colony optimization algorithm [6]. The problem consists of a variation of STOP in which no mandatory vertices are considered, and the vehicles do not necessarily depart from the same origin. It models the problem of evacuating the greatest possible number of people from a risky area and transferring them to a unique destination shelter using the available and limited resources.  To the best of my knowledge, this project is the first work to address an RO version of STOP. |
| **1.3 Research Methodology**  The main goal of this project is to propose innovative and efficient solutions for RO versions of FLP and STOP addressing applications in post disaster relief operations in the Normandy region. To this end, I intend to follow two research directions: (i) mathematical programming-based heuristics (mat-heuristics), and (ii) metaheuristics. Solving combinatorial optimization problems through integer programming is an NP-hard task in general. As a result, ways of addressing these problems by approximate and heuristic methods have been widely investigated in the literature [21]. An interesting research path consists in combining the mathematical formalism of mixed integer programming formulations with the flexibility and scalability of metaheuristics, thus yielding the so-called mat-heuristics. Thus, this hybridization of mathematical programming and metaheuristic is able to explore the search space in a mathematically guided way, while still avoiding the possibly big memory and time requirements that might be brought by pure mathematical programming methods.  In this first research path, there is a wide range of possibilities to be explored, especially in terms of rounding and diving mat-heuristics (for instance, Relaxation Induced Neighborhood Search (RINS) [10], feasibility pump [15] and objective feasibility pump [1]), or even simpler constructive ad-hoc heuristics. In particular, an interesting heuristic framework called Kernel search [2], which is based on the identification of promising variables (kernel) of a given model, can also be investigated for the problems at hand. For the specific case of RO problems, a promising alternative is to apply a mat-heuristic framework that I have helped devise [5], which uses dual information and is extensible to any interval data min-max regret RO problem modelled by means of 0-1 integer linear programming.  Although the potential of mat-heuristics in solving classical optimization problems can already by supported by several studies, following this research direction in this project has two main risks. First, RO problems have an extra layer of difficulty, as devising compact (with a polynomial number of constraints and variables) formulations is not a trivial task in most of the cases, especially when the classical counterpart of the problem is already NP-hard. Second, in humanitarian relief, highly efficient solutions (in terms of execution time) are crucial, which is an extra challenge for methods that, as most of the mat-heuristics, involve solving linearly relaxed models many times.  To mitigate the aforementioned risks, I intend to also conduct research in the more conservative direction of classical metaheuristics. In this case, potential alternatives for investigation are (i) local search based metaheuristics, such as simulated annealing, tabu search, iterated local search, variable neighborhood search and Greedy Randomized Adaptive Search Procedure (GRASP), or (ii) population based metaheuristics (ant colony, particle swarm optimization, genetic algorithm, etc). |
| **1.4 Inclusion of international, interdisciplinary and/or intersectoral aspects**  A key factor for the effectiveness of an optimization algorithm is the quality and accuracy of the input data provided. In this context, Machine Learning (ML) and regression techniques are powerful tools to estimate costs, expected demands and other uncertain data that can be inferred by historical data.  Accordingly, the main interdisciplinary aspect of this project takes place in the collection and treatment of data to build input for the optimization algorithms proposed. A natural result and presuppose of this project is a close collaboration between the two teams in the Host research unit which study these topics: the *Apprentissage* (APP) laboratory and the *Réseaux d’interactions et Intelligence Collective* (RI2C). They conduct research mainly in Artificial Intelligence (including ML) and Logistics (including OR), respectively.  Aside from deepening the collaboration within the Host institution, another possibility to be explored is promoting scientific interchange of knowledge with the Brazilian institution where I did my P.h.D., namely *Universidade Federal de Minas Gerais* (UFMG). UFMG has a strong board of scientists in the field of OR, stochastic programming and robust optimization, as well as in linear and non-linear integer programming. Therefore, this project has also potential to be a starting point for an important international partnership between the two institutions. |
| **References**  [1] Tobias Achterberg and Timo Berthold. Improving the feasibility pump. Discrete Optimization, 4(1):77 – 86, 2007.  [2] Enrico Angelelli, Renata Mansini, and M. Grazia Speranza. Kernel search: A general heuristic for the multi-dimensional knapsack problem. Computers & Operations Research, 37(11):2017–2026, 2010.  [3] Lucas Assunção and Geraldo Robson Mateus. A cutting-plane algorithm for the Steiner team orienteering problem. Computers & Industrial Engineering, 135:922 – 939, 2019.  [4] Lucas Assunção and Geraldo Robson Mateus. Coupling feasibility pump and large neighborhood search to solve the Steiner team orienteering problem. Computers & Operations Research, 128(105175), 2021.  [5] Lucas Assunção, Thiago F. Noronha, Andréa Cynthia Santos, and Rafael Andrade. A linear programming based heuristic framework for min-max regret combinatorial optimization problems with interval costs. Computers & Operations Research, 81:51–66, 2017.  [6] Ilaria Baffo, Pasquale Carotenuto, and Stefania Rondine. An orienteering-based approach to manage emergency situation. Transportation Research Procedia, 22:297–304, 2017.  [7] Thiago Jobson Barbalho, Andréa Cynthia Santos, and Dario José Aloise. Metaheuristics for the work-troops scheduling problem. International Transactions in Operational Research, 2020.  [8] Chawis Boonmee, Mikiharu Arimura, and Takumi Asada. Facility location optimization model for emergency humanitarian logistics. International Journal of Disaster Risk Reduction, 24:485–498, 2017.  [9] Amadeu A. Coco, Christophe Duhamel, and Andréa Cynthia Santos. Modeling and solving the multi-period disruptions scheduling problem on urban networks. Annals of Operations Research, 285:427–443, 2020.  [10] Emilie Danna, Edward Rothberg, and Claude Le Pape. Exploring relaxation induced neighborhoods to improve MIP solutions. Mathematical Programming, 102(1):71–90, 2005.  [11] G. B. Dantzig, D. R. Fulkerson, and S. M. Johnson. Solution of a large-scale traveling-salesman problem. Operations Research, 2:393–410, 1954.  [12] Zvi Drezner. Facility Location: A Survey of Applications and Methods. Springer, 1995.  [13] Christophe Duhamel, Andréa Cynthia Santos, Daniel Brasil, Eric Châtelet, and Babiga Birregah. Connecting a population dynamic model with a multi-period location-allocation problem for post-disaster relief operations. Annals of Operations Research, 247:693–713, 2016.  [14] Zehranaz Dönmez, Bahar Y. Kara, Özlem Karsu, and Francisco Saldanha da Gama. Humanitarian facility location under uncertainty: Critical review and future prospects. Omega, 102:102393, 2021.  [15] Matteo Fischetti, Fred Glover, and Andrea Lodi. The feasibility pump. Mathematical Programming, 104(1):91–104, 2005.  [16] Aldy Gunawan, Hoong Chuin Lau, and Pieter Vansteenwegen. Orienteering problem: A survey of recent variants, solution approaches and applications. European Journal of Operational Research, 255(2):315 – 332, 2016.  [17] Saïd Hanafi, Renata Mansini, and Roberto Zanotti. The multi-visit team orienteering problem with precedence constraints. European Journal of Operational Research, 282(2):515–529, 2020.  [18] Yipeng Huang, Andréa Cynthia Santos, and Christophe Duhamel. Model and methods to address urban road network problems with disruptions. International Transactions in Operational Research, 27(6):2715–2739, 2020.  [19] Liangjun Ke, Laipeng Zhai, Jing Li, and Felix T.S. Chan. Pareto mimic algorithm: An approach to the team orienteering problem. Omega, 61:155 – 166, 2016.  [20] Adam N. Letchford, Saeideh D. Nasiri, and Dirk Oliver Theis. Compact formulations of the Steiner traveling salesman problem and related problems. European Journal of Operational Research, 228(1):83–92, 2013.  [21] Nina Mazyavkina, Sergey Sviridov, Sergei Ivanov, and Evgeny Burnaev. Reinforcement learning for combinatorial optimization: A survey. Computers & Operations Research, 134, 2021.  [22] Pitu B. Mirchandani and Richard L. Francis. Discrete location theory. Wiley, 1990.  [23] Ragheb Rahmaniani, Mohammad Saidi-Mehrabad, and H Ashouri. Robust capacitated facility location problem: Optimization model and solution algorithms. Journal of Uncertain Systems, 7:22–35, 02 2013.  [24] T. Tsiligirides. Heuristic methods applied to orienteering. The Journal of the Operational Research Society, 35(9):797–809, 1984.  [25] Pieter Vansteenwegen, Wouter Souffriau, and Dirk Van Oudheusden. The orienteering problem: A survey. European Journal of Operational Research, 209(1):1 – 10, 2011.  [26] Yu-Jun Zheng, Sheng-Yong Chen, and Hai-Feng Ling. Evolutionary optimization for disaster relief operations: A survey. Applied Soft Computing, 27:553–566, 2015.  [27] Shiva Zokaee, Ali Bozorgi-Amiri, and Seyed Jafar Sadjadi. A robust optimization model for humanitarian relief chain design under uncertainty. Applied Mathematical Modelling, 40(17):7996–8016, 2016. |
| **2. Impact of the project *(approx. 3 pages)*** |
| **2.1 Impact**  This project meets directly the Smart Specialisation Strategy (S3) goal of making Normandy a resilient territory by mastering technological, natural, health and social risks, as the optimization problems addressed in this study model, as generically as possible, situations of response/rescue after natural/industrial disasters. In fact, I intend to use data from real incidents to build test instances and assess the performance of the proposed methods in the experiments to be conducted. The idea is to use information compiled by the Centre for Research on the Epidemiology of Disasters (CRED), which was made available in their Emergency Events Database (EM-DAT, https://www.emdat.be/). Upon access to data related to incidents within Normandy, they should also be included in the experiments.  In particular, the project contributes to two of the S3 areas/ambitions for 2027:   * **New technologies for risk anticipation and prevention:** develop applications of these technologies for anticipation and prevention of risks in order to make Normandy a resilient territory for 2027; * **Practice for risk management:** make Normandy a resilient territory towards human or natural changes and risks.   This project will also sum up efforts with the current initiatives in the Host institution on planning robust strategies for dealing with emergency incidents in Normandy. There are two projects currently active in this topic, but focusing on applications using Unmanned Aerial Vehicle (UAV). In my project, the mathematical modelling and algorithmic approaches have as premise operations by land vehicles, thus matching the ongoing projects in a complementary way.  In terms of scientific contribution, this project has two main impacts:   * **Assess the potential of mat and metaheuristics in disaster relief optimization under uncertainty:** although there are already several works proposing algorithmic solutions for planning operations in emergency events, dealing with the uncertainty involved in the input data is mainly neglected or modelled through scenario stochastic programming. Then, the first goal of this project is to further explore RO as an alternative to model these situations, which require fast and dynamic responses under uncertain conditions. In particular, I intend to experimentally evaluate if model-based mat-heuristic and metaheuristic frameworks can be sufficiently efficient in these cases; * **Solving a challenging theoretical problem through innovative methods:** as mentioned in Section 1.2, STOP is a particularly complex combinatorial problem, as finding an initial feasible solution for it is already NP-hard. Then, devising innovative and efficient methods for this problem is also a relevant contribution from the theoretical point of view. |
| **2.2 Career Development**  I discovered my passion for research and optimization in the beginning of my second year of undergraduate in Computer Science at *Universidade Federal do Ceará* (UFC), Brazil, where I joined the research group of Parallelism, Graphs and Optimization. Since this first contact, I started to picture myself as a full-time researcher in the long-term. Nevertheless, due to the non-favorable research conditions in Brazil in the last years, I started to search for job positions outside Academia. Accordingly, during my last year of P.h.D., I also worked as an independent optimization consultant/developer and, in the last three years, I have been working as an optimization software engineer and data scientist: I have started at a Belgian company whose main product is a proprietary software for supply chain solutions and, later, contributed to optimizing logistic and production operations in a latin american *e-commerce* shipment company and in an European steel producer.  My last professional experiences gave me the chance of dealing with “real-world” applications in OR while working in multicultural teams. Nevertheless, at this point, I see this Fellowship as a great opportunity to further enrich my knowledge and get back to something that I have been passionate about since my early days in college: doing research.  The first aspect of this Fellowship that attracts me is the possibility of working with autonomy, by selecting a research topic that is in accordance with both my personal interests and Normandy Smart Specialisation Strategy's goals. Also in this sense, I see it as a great opportunity to broaden my knowledge and fill some gaps in my academic development. Although I have already had contact with mat and metaheuristics, my main works involve exact approaches (especially cutting-planes and Benders' decomposition). Then, this project is an opportunity to dive into the vast collection of non-exact techniques available in the literature.  The Host institution I have chosen to conduct my project particularly attracts me due to its board of researchers in the field of humanitarian optimization. Aside from my adviser Andréa Cynthia Santos, a few researchers from laboratories at *Le Havre Normandy Universite* have expertise in this field: Christophe Duhamel, Eric Sanlaville, Adan Yassine, Anne Pantet and Christophe Bisiaux. Some of them already have and/or had ongoing or previous collaborations with my advisor. Moreover, I am aware of the existence of organizations in the region dedicated to planning risk management initiatives in industrial activities: ORMES (https://www.ormes.fr) and Synerzip-lh (https://www.synerzip-lh.fr). They can be important sources of input data for devising scenarios in computational experiments.  At last, the experience of living abroad, getting in contact with a different culture and expanding my professional and social networks surely make the opportunity even more attractive. In summary, I believe this Fellowship meets my short and long-term goals of getting back to research, making my know-how portfolio more robust and becoming a full-time researcher in a well-regarded academic institution. |
| **2.3 Transfer of knowledge and training**  This project will be hosted by *Le Havre Normandy University* (ULHN), more precisely by the *Laboratoire d’Informatique, du Traitement de l’Information et des Systèmes* (LITIS). There, I intend to work in the *Réseaux d’interactions et Intelligence Collective* (RI2C) team, which has an history on solving several applications covering different phases of disaster handling, such as assessment, readiness, relief and recovery. This team also deals with dynamic systems, optimization and logistics in general. The LITIS-RI2C has a strategical position in the Normandy territory on these applications, with several past and recent projects on the topic. To name a few: (i) ASTREOS (*Maîtrise des flux dans les systèmes socio-techniques),* from 2018 to 2020; (ii) FEDER AMED (Multidisciplinary analysis of Domino effects), from 2017 to 2020; and, more recently, (iii) ANR LIAD (Optimizing and valorizing sites’ dismantling in the aftermath of industrial disasters in urban areas – A reverse logistics application) and (iv) FEDER-FSE LIS (Logistics operations after industrial disasters).  Aside from the intellectual resources available in the LITIS team, the research unit chosen also has the structural means to support my research. In practical terms, the LITIS-RI2C has a powerful grid machine for the computational experiments needed, physical space for my office, and can also provide me a personal computer. Moreover, the team can help me broaden my professional network through the several associations it collaborates with (like SINERZIP-LH, ORMES and ROADEF). As a result, I believe that the Host institution (and the specific research unit) chosen is the perfect place to re-engage myself with research, having all the means (both structural/technological and scientific/intellectual) to help me achieve the personal and professional goals involved in this project.  Now, let me outline my professional and personal skills that match the Host institution interests. From my previous and current experiences as a researcher and a developer, I could build a solid basis in Computer Science and OR, with strong foundations in linear and integer programming, mathematical modelling, robust optimization, graph theory and network optimization. Furthermore, at this point of my career, I feel capable enough of conducting research with autonomy as well as in close collaboration with other researchers.  My main previous experiences as a researcher were focused on transportation problems, both in classical/deterministic vehicle routing and in versions taking into account uncertainty (in particular, robust optimization). Moreover, my professional experiences in private companies addressed logistics and supply chain problems, with focus on inventory optimization. Since the chosen Host institution has several ongoing projects in the field of logistics, I believe my knowledge and experience in transportation and inventory optimization fit the institution's needs.  Moreover, my academic background in more theoretical research, combined with my last experiences with more applied “real-world” research and development, have helped me broaden my analytical skills. With this mixture of academic and industrial experiences, I have learned to depict and solve mathematical problems in a less conservative, yet pragmatic, manner.  This ability can be useful when building connections between academic and social/industrial environments, either when assessing possible application's needs or communicating the research findings to a broader audience in a less technical language. |
| **2.4 Communication, Dissemination and exploitation of results**  As a first way of sharing the research findings, I intend to present preliminary and final results throughout the course of the Fellowship in seminars within the Host Research unit. I believe that sharing the results in early stages of the research is particularly important to obtain feedback and insights from a qualified audience, thus identifying flaws and possible improvements as soon as possible.  Once the research reaches more mature levels and the first consistent contributions are achieved, I plan to expose the results in international conferences, according to the impact of the findings. International conferences are usually a good occasion to share scientific contributions with a broader, yet selected, audience. Particularly in OR, they are also a starting point for submissions of full papers to peer-reviewed journals in subsequent special issues. At last, according to the relevance of the project's outcomes, I intend to submit the compilation of the findings to well-regarded journals in OR. Ideally, *International Journal of Disaster Risk Reduction*, *Computers & Operations Research*, *European Journal of Operational Research* and *Transportation Science* are examples of journals in which I aim to publish the findings.  In terms of international conferences, I believe the scopes of *International Symposium on Combinatorial Optimization (ISCO)* and *International Workshop on Model-Based Metaheuristics* might fit the research directions I intend to follow in this project. |
| **3. Implementation of the project *(approx. 3 pages)*** |
| **3.1 Work programme, resources**  The main macro activities planned for the 24-month horizon of this Fellowship are described as follows.   1. **Literature review:**    1. studies addressing the classical counterparts of the RO problems of interest in this study, trying to identify solution approaches that can be extended to RO. Since the RO solutions also rely on efficiently solving the classical counterparts, it is also crucial to select the state-of-the-art classical approaches in these cases;    2. literature on disaster relief problems, focusing on solutions modelling uncertainty via RO;    3. most recent trends on mat-heuristics and metaheuristics in general, trying to identify which ones can be adapted to RO cases; 2. **Writing and dissemination of results:** the process of writing scientific material should be performed throughout the Fellowship horizon, in an incremental way, by the time each planned activity is concluded. This continuous process includes (i) preparing and performing public presentations of the results achieved by the research and (ii) the compilation of the results to be submitted to peer-reviewed conferences/journals; 3. **Building test instances**: effort should be dedicated to analysing the data available in the Emergency Events Database (EM-DAT, https://www.emdat.be/) and other sources in order to build test instances to be used in the computational experiments; 4. **Devising and developing solution approaches:** this is a crucial step in the project, consisting of defining the most promising techniques in the literature that fit the specific needs of the optimization problems addressed. They should be carefully selected (based on the state-of-the-art literature) and adapted to the problems of interest in this study. Also in this phase, the actual development/coding of the algorithms takes place. The idea is to apply, whenever possible, the same general meta and mat-heuristic frameworks to both problems addressed. Accordingly, this phase should be done for the two research directions chosen in an independent way:    1. Mat-heuristic(s);    2. Metaheuristics(s); 5. **Computational experiments:** an extensive set of experiments should be performed to fine-tune and assess the performance of the algorithms proposed at solving the test instances. These experiments should be done separately for the two research directions chosen:    1. Mat-heuristic(s);    2. Metaheuristics(s); 6. **Statistical study of the results:** heuristic solution often rely on non-deterministic algorithmic choices based on probability. For these cases, it is relevant to perform statistical tests (e.g., Wilcoxon, Iman-Davenport and Nemenyi tests) to ensure that the results obtained are statistically significant (i.e., not attributed to chance):    1. Mat-heuristic(s);    2. Metaheuristics(s);   The expected time schedule for the aforementioned activities within the 24-month horizon of the Fellowship is detailed in Figure 1.    Figure 1. Expected time schedule for the activities planned.  Two types of deliverables are expected as outcome of this project:   * **Software application:** core algorithms devised and experimentally tested in the research. Ideally, at least two algorithms (a metaheuristic and a mat-heuristic) for each research problem to be followed in the project: * Mat-heuristic-based algorithms: coded in C++, possibly using ILOG CPLEX (https://www.ibm.com/analytics/cplex-optimizer) or Gurobi (https://www.gurobi.com) as mathematical solvers; * Metaheuristic algorithms: coded in C++.   User-friendly interface for input and output of data to/from the application should also be provided (possibly in Python);   * **Research paper(s):** according to the impact of results of the experiments conducted on the algorithms developed, compile the findings in the format of short and full paper(s), to be submitted for publication in appropriate peer-reviewed international conferences and journals.   In practical terms, three main indicators can help assess the success level of the project:   * How many of the activities planned in the programme were finished within the pre-established horizon. In particular, were the planned deliverables actually delivered by the end of the project? * Do the proposed algorithms outperform the sate-of-the-art literature in terms of time execution speed? Are the favourable results reproducible when considering instances built from real historical data related to natural/industrial disasters? * Were the resulting research papers submitted/published in journals/conferences of high impact factor?   Regarding resources, there is limited need, as the project relies mainly on computational experiments. As mentioned in Section 2.3, the Host research unit already has the resources needed for my work, which are (i) a powerful grid machine for the computational experiments needed, (ii) physical space for my office, and (iii) a personal computer for coding the proposed algorithms, compiling results and writing the scientific papers. |
| **3.2 Name of the Host Institution and the Host Research unit**  The institution and research unit chosen to host this project are *Le Havre Normandy Universite* (ULHN) and *Laboratoire d’Informatique, du Traitement de l’Information et des Systèmes* (LITIS), respectively. In particular, the project fits the scope of *the Réseaux d’interactions et Intelligence Collective* (RI2C) laboratory within LITIS. The ULHN-LITIS-RI2C conducts research on complex systems, focusing on the interactions and collective intelligence of systems. Its researchers study dynamic systems, optimization and logistics, with application in transport, disasters management, among other topics. |

## CV – Track Record

The CV-Track record should be limited to a **max 5 pages in total** (incl. list of publications) and should include the standard academic and research record.

Apart from the standard academic and research fields, **please complete the information below by following this template** (in reverse chronological order) and delete the items when non-applicable:

1. *Personal administrative dat*a (name, first name, date of birth, nationality, reference ID…)

Name: Assunção de Almeida  
First name: Lucas  
Date of birth: April 18th, 1988  
Nationality: Brazilian  
Passport number: FT521571

1. *Education*

* Ph.D. Production Engineering | Sept. 2015 – Aug. 2019  
  Institution: Universidade Federal de Minas Gerais, Belo Horizonte, Brazil  
  Major: Operational Research  
  Advisor: Geraldo Robson Mateus  
  Project title: Optimization algorithms for the Steiner team orienteering problem
* M.Sc. Computer Science | Mar. 2013 – Mar. 2015  
  Institution: Universidade Federal de Minas Gerais, Belo Horizonte, Brazil  
  Major: Operational Research  
  Advisor: Thiago F. Noronha | Co-advisor: Andréa Cynthia Santos  
  Project title: Optimization algorithms for the restricted robust shortest path problem
* B.Sc. Computer Science | Jul. 2007 – Dec. 2011  
  Institution: Universidade Federal do Ceará, Fortaleza, Brazil  
  Global weighted average grade: 9.215/10.0

1. *Current and previous positions (please highlight international and cross-domain experience)*

• **Senior Optimization Data Scientist** | **Arcelormittal**, Espírito Santo, Brazil | Sept. 2022 – present  
Description: part of the Advanced Analytics team, responsible for mapping opportunities of process improvement within the steel production plants and devising solutions combining Machine Learning and Optimization.  
Technologies: Python, C++, Gurobi, git  
• **Senior Optimization Analyst** | **Mercado Livre**, São Paulo, Brazil | Jun. 2021 – Aug. 2022  
Description: part of the Shipment Optimization Team (SOT), responsible for planning through optimization algorithms the logistic operations (scheduling, inventory placement, bin packing, first-mile and last-mile transportation, etc) underlying Mercado Livre’s e-commerce platform. In particular, I was an analyst in the project of Inventory Placement and my work consists of proposing and developing algorithms for distributing the inbounds through the available facilities/warehouses, while taking into account transportation costs, demand forecasting and capacity restrictions.  
Technologies: Golang, C++, CPLEX, git  
• **Software Engineer (Optimization)** **| OMP, Antwerp, Belgium** | Jun. 2020 - May 2021  
Description: worked in the support and extension of heuristic solvers developed within the proprietary software for supply chain solutions. I have mainly worked on heuristics to guide and optimize inventory replenishment and reduce overload on machines used for production, while taking into account complex supply chain restrictions, such as allocation/pegging constraints.  
Technologies: C++, git, SVN  
• **Senior Optimization Consultant** | **OMP**, São Paulo, Brazil | Sept. 2019 - Jun. 2020

Description: responsible for configuring, fine tuning and coding within the OMP’s supply chain tool, which integrates all levels of the supply chain — from operational to tactical/strategic decisions. The software has optimization solvers as its core and my main role was to apply Mixed Integer Programming (MIP) fundamentals to model customer-specific constraints used in simulations of cost-profit scenarios.  
Technologies: C++ like proprietary programming language, SVN  
• **Researcher** | **Universidade Federal de Minas Gerais** | Sept. 2015 - Aug. 2019  
Description: design and development of exact and heuristic algorithms for a class of classical routing problems with profit collection, namely orienteering problems. The main contributions of the research are:  
\* a new cutting-plane algorithm (along with three classes of valid inequalities/logic cuts) able to solve to optimality 15 more instances than any other previous exact algorithm and find eight new optimality certificates;  
\* proposal of mat-heuristics based on Feasibility Pump and a Large Neighbourhood Search (LNS)  
heuristic with a long-term memory component based on Path Relinking  
Technologies: C++, CPLEX  
• **Freelance** Optimization Consultant | **Concert Technologies**, Belo Horizonte, Brazil | Aug. 2016 - Apr. 2017  
Description: devised and developed the optimization algorithm called within a tool responsible for planning the pruning of trees interfering with electrical grids in urban areas. The application takes into account resource constraints (such as costs, work horizon, etc) and works on real world city-based networks with up to 6000 electrical posts  
Technologies: C++, CPLEX  
• **Researcher** | **Universidade Federal de Minas Gerais** | Mar. 2013 - Mar. 2015  
Description: design and development of optimization algorithms for robust optimization versions of classical NP-hard combinatorial problems. Two main contributions can be highlighted:  
\* a linear programming based heuristic framework for a class of min-max regret robust optimization problems. The heuristic improves the bounds obtained by a classical 2-approximation algorithm. While solving two problems in the class, the average bound improvements were up to 20.88% and 29.31%  
\* the first formal proof of the finite convergence of a widely used logic-based Benders’ framework from the literature of robust optimization  
Technologies: C++, CPLEX  
• **Systems Analyst** | **Database and Systems Laboratory**, Fortaleza, Brazil | Mar. 2012 – Oct. 2012  
Description: part of the team responsible for the development of the multi-platform hardware diagnostic tool for laptops and desktop computers manufactured by LENOVO:  
\* Collaborated on the development of the command line interface of the application, dealing with  
argument parsing, log generation, concurrency and pipeline buffer synchronization  
\* Devised and implemented test cases for unit testing the application  
Technologies: C++, Google Test C++

1. *Teaching, supervising and mentoring activities*

* Teaching Assistant | Feb. 2017 – Jun. 2017  
  Description: assistance in mentoring students enrolled in the course of Convex and Linear Programming, at the department of Production Engineering, Universidade Federal de Minas Gerais, Brazil.
* Teaching Assistant | Feb. 2014 – Jun. 2014  
  Description: assistance in mentoring students enrolled in the course of Heuristics and Metaheuristics, at the department of Computer Science, Universidade Federal de Minas Gerais, Brazil.

1. *Scientific evaluation/ reviewing activities*

* Peer review for international journals:
  + Computers & Operations Research
  + International Journal of Production Research
  + Expert Systems with Applications
* Peer review for international conference:
  + 4th International Symposium on Combinatorial Optimization, ISCO 2016

1. *Funding received so far*

• Scholarship | Ph.D. level | Sept. 2015 – Aug. 2019  
Funding agency: Brazilian National Council for Scientific and Technological Development (CNPq)  
• Scholarship | M.Sc. level | Mar. 2013 – Mar. 2015  
Funding agency: Coordination for the Improvement of Higher Education Personnel, Brazil (CAPES)  
• Scholarship | Scientific Initiation level | Apr. 2010 – Dec. 2011  
Funding agency: Brazilian National Council for Scientific and Technological Development (CNPq)

1. *10 major publications in peer-reviewed scientific journals, peer-reviewed conference proceedings and/or monographs of their respective research fields, indicating also the number of citations (excluding self-citations) they have attracted*

• Publications in peer-reviewed journals (in reverse chronological order)  
– Assunção, Lucas; Santos, Andréa Cynthia; Noronha, Thiago F.; Andrade, Rafael. Improving logic-based Benders’ algorithms for solving min-max regret problems. Operations Research and Decisions, v. 128, n. 2, Sept. 2021. Citations (excluding self-citations): 0  
– Assunção, Lucas; Mateus, Geraldo Robson. Coupling Feasibility Pump and Large Neighborhood Search to solve the Steiner team orienteering problem. Computers & Operations Research, v. 128, April 2021. Citations (excluding self-citations): 2  
– Assunção, Lucas; Mateus, Geraldo Robson. A cutting-plane algorithm for the Steiner team orienteering problem. Computers & Industrial Engineering, v. 135, p. 922-939, 2019. Citations (excluding self-citations): 3  
– Assunção, Lucas; Noronha, Thiago F.; Santos, Andréa Cynthia; Andrade, Rafael. A linear programming based heuristic framework for min-max regret combinatorial optimization problems with interval costs. Computers & Operations Research, v. 81, p. 51-66, 2017. Citations (excluding self-citations): 8  
– Assunção, Lucas; Santos, Andréa Cynthia; Noronha, Thiago F.; Andrade, Rafael. On the Finite Optimal Convergence of Logic-Based Benders’ Decomposition in Solving 0–1 Min-Max Regret Optimization Problems with Interval Costs. In: Cerulli R., Fujishige S., Mahjoub A. (eds) 4th International Symposium on Combinatorial Optimization (ISCO), Vietri sul Mare, Italy, 2016. Lecture Notes in Computer Science, vol 9849. Springer, Cham, 2016. Citations (excluding self-citations): 1  
• Proceeding/presentations in international conferences (in reverse chronological order)  
– Assunção, Lucas; Santos, Andréa Cynthia; Noronha, Thiago F.; Andrade, Rafael. On the Finite Optimal Convergence of Logic-Based Benders’ Decomposition in Solving 0–1 Min-Max Regret Optimization Problems with Interval Costs. 4th International Symposium on Combinatorial Optimization (ISCO), Vietri sul Mare, Italy, 2016  
– Assunção, Lucas; Noronha, Thiago F.; Santos, Andréa Cynthia; Andrade, Rafael. A linear programming based heuristic for robust optimization problems: a case study on solving the restricted robust shortest path problem. 5th International Workshop on Model-Based Metaheuristics, 2014, Hamburg, Germany  
• Proceedings/presentations in Brazilian conferences  
– Assunção, Lucas; Noronha, Thiago F.; Santos, Andréa Cynthia; Andrade, Rafael. Uma Heurística baseada em Programação Linear para o Problema do Caminho Mínimo Robusto Restrito. XLVI Simpósio Brasileiro de Pesquisa Operacional (SBPO), 2014, Salvador, Brazil

## Ethics self-assessment

Please complete the table below and comment if necessary. For full guidelines on each area, please refer to the H2020 ethics self-assessment guide ["How](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf) [to Complete your Ethics Self-Assessment"](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf)  available at:

<http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf>

“*I confirm that I have taken into account all ethics issues described below and that, if any ethics issues apply (any Yes identified in the below table), I will complete an ethics self-assessment document following the H2020 ethics self-assessment guide and attach the required documents to my application.”*

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Yes | No |
| 1. **Human embryos/foetuses** | | | |
| Does your research involve Human Embryonic Stem Cells (hESCs)[[7]](#footnote-7)? | |  |  |
| If yes : | Will they be directly derived from embryos within this project? |  |  |
| Are they previously established cell lines? |  |  |
| Does your research involve the use of human embryos? | |  |  |
| If yes : | If yes will the research lead to their destruction? |  |  |
| Does your research involve the use of human foetal tissues/cells? |  |  |
| 1. **Humans** | | | |
| Does your research involve human participants? | |  |  |
| If yes : | Are they volunteers for social or human sciences research? |  |  |
| Are they persons unable to give informed consent? |  |  |
| Are they vulnerable individuals or groups? |  |  |
| Are they children/minors? |  |  |
| Are they patients? |  |  |
| Are they healthy volunteers for medical studies? |  |  |
| Does your research involve physical interventions on the study participants? | |  |  |
| If yes : | Does it involve invasive techniques? |  |  |
| Does it involve collection of biological samples? |  |  |
| If your research involves processing of genetic information, see also section 4. | | | |
| 1. **Human cells/tissues** | | | |
| Does your research involve human cells or tissues (other than from Human Embryos/Foetuses, i.e. section 1)? | |  |  |
| If yes : | Are they available commercially? |  |  |
| Are they obtained within this project? |  |  |
| Are they obtained within another project, research unit or institution? |  |  |
| Are they deposited in a biobank? |  |  |
| 1. **Personal data** | | | |
| Does your research involve personal data collection and/or processing? | |  |  |
| If yes : | Does it involve the collection and/or processing of sensitive personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)? |  |  |
| Does it involve processing of genetic information? |  |  |
| Does it involve profiling, systematic monitoring of individuals or processing of large scale of special categories of data, intrusive methods of data processinges it involve tracking or observation of participants? |  |  |
| Does your research involve further processing of previously collected personal data (secondary use)? | |  |  |
| Does your research involve publicly available data? | |  |  |
| *Is it planned to export personal data from the EU to non-EU countries? (specify the type of personal data and countries involved)* | |  |  |
| *Is it planned to import personal data from the EU to non-EU countries? (specify the type of personal data and countries involved)* | |  |  |
| 1. **Animals** | | | |
| Does your research involve animals? | |  |  |
| If yes : | Are they vertebrates? |  |  |
| Are they non-human primates? |  |  |
| Are they genetically modified? |  |  |
| Are the cloned farm animals? |  |  |
| Are they endangered species? |  |  |
| 1. **Third countries** | | | |
| In case of non-European countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?  If yes, please specify the countries involved (max 1000 characters):  Please notice that “*in case activities undertaken in non-EU countries raise ethics issues, the applicants must ensure that the research conducted outside the EU is legal in France”.* | |  |  |
| Is it planned to use local resources (e.g. animal; and/or human tissues samples, genetic material, live animals, human remains, materials for historical value, endangered fauna or flora samples, etc.)? | |  |  |
| Do you plan to import any material from non-EU countries into the EU?  *For data imports, please fill in also section 4.*  *For imports concerning human cells or tissues, fill in also section3.*  If yes, please specify the material and countries involved (max 1000 characters): | |  |  |
| Do you plan to export any material from non-EU countries into the EU?  *For data exports, please fill in also section 4.*  *For exports concerning human cells or tissues, fill in also section3.*  If yes, please specify the material and countries involved (max 1000 characters): | |  |  |
| In case research involves low and/or lower-middle income countries, are any benefit-sharing actions planned? | |  |  |
| 1. **Environment, and health and safety** | | | |
| Does your research involve the use of elements that may cause harm to the environment, to animals or plants?  *For research involving animal experiments, please fill in also section 5.* | |  |  |
| Does your research deal with endangered fauna and/or flora and/or protected areas? | |  |  |
| Does your research involve the use of elements that may cause harm to humans, including research staff? | |  |  |
| 1. **Dual use** | | | |
| Does your research involve dual-use items in the sense of Regulation 428/2009[[8]](#footnote-8), or other items for which an authorisation is required? | |  |  |
| 1. **Exclusive focus on civil applications** | | | |
| Could your research raise concerns regarding the exclusive focus on civil applications? | |  |  |
| 1. **Misuse** | | | |
| Does your research have the potential for misuse (malevolent/criminal/terrorist abuse,..) of research results? | |  |  |
| 1. **Other ethics issues** | | | |
| Are there any other ethics issues that should be taken into consideration? If so, please specify (max 1000 characters): | |  |  |

If you have entered any issues in the ethics issue table, **you must perform an ethics self-assessment in accordance with the guidelines “**[**How**](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf)[**to Complete your Ethics Self-Assessment”**](http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/ethics/h2020_hi_ethics-self-assess_en.pdf) **and complete the table below.**

|  |
| --- |
| **Ethical dimension of the objectives, methodology and likely impact** |
| Explain in detail the identified issues in relation to:   * objectives of the activities (e.g. study of vulnerable populations, etc.) * methodology (e.g. clinical trials, involvement of children, protection of personal data, etc.) * the potential impact of the activities (e.g. environmental damage, stigmatisation of particular social groups, political or financial adverse consequences, misuse, etc.)   N/A. |

|  |
| --- |
| **Compliance with ethical principles and relevant legislations** |
| Describe how the issue(s) identified in the ethics issues table above will be addressed in order to adhere to the ethical principles and what will be done to ensure that the activities are compliant with the E U / national legal and ethical requirements of the country or countries where the tasks are to be carried out. Please join any necessary supporting documents via the “other documents” annex.  N/A. |

## Recommendation letters

Two recommendation letters should be provided for your application and uploaded separately.

The letters should be provided from prior supervisors, professors, co-workers, and they shall precise their position (director, researcher, etc.), title (Prof., Dr., Mr., Mrs.,…), name, first name, e-mail, and telephone number.

**No application can be submitted without all the information required. The following annexes should be uploaded as a separate document on the platform together with the filled application form to be considered as eligible :**

# ANNEX 1 - IDENTITY DOCUMENT

Please upload an identity document (ID card, valid passport…) as a separate PDF document on the platform.

# ANNEX 2 - PHD DOCUMENT

Please upload you PhD diploma, PhD letter of commitment or any equivalent document justifying at least four years of full-time equivalent research experience (work certificates…) as a separate document on the platform.

# ANNEX 3 - RECOMMENDATION LETTER 1

Please upload the first one recommendation letter as a separate document on the platform.

# ANNEX 4 - RECOMMENDATION LETTER 2

Please upload a second recommendation letter as a separate document on the platform.

# ANNEX 5 - OTHER DOCUMENTS

Please upload any other necessary documents needed for the evaluation of the proposal (ethics approvals, supporting documents for MSCA special needs allowance…)

1. See definition of Full-Time Equivalent Research Experience in the Application Guide and FAQ [↑](#footnote-ref-1)
2. Please count only time spent in months on research activities. [↑](#footnote-ref-2)
3. Please count only time spent until the 2022 call deadline (October, 14th, 2022) or the end of the PhD, whichever comes first. [↑](#footnote-ref-3)
4. Please see the details on secondments and definition of evaluation criteria in the Application Guide of the call. [↑](#footnote-ref-4)
5. Please see the definition of a doctoral degree in the Application Guide of the call. [↑](#footnote-ref-5)
6. Please refer to the keywords list into the Guide for Applicant [↑](#footnote-ref-6)
7. <https://ec.europa.eu/research/participants/data/ref/h2020/legal_basis/fp/h2020-eu-decl-fp_en.pdf> [↑](#footnote-ref-7)
8. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32009R0428> [↑](#footnote-ref-8)