Regional Program
Scientific Cooperation

STIC – AmSud

Evaluation of on-going projects

Deadline : 15th October 2013

Project Title:	Solving Combinatorial Optimization Problems with Stable Sets Constraints
Investigation Area:	Combinatorial Optimization, Integer Programming, Operational Research
Starting year:	2013

Project Website:	http://www.lia.ufc.br/sticamsud/

International Coordinator

Name:	Manoel Campêlo
Country:	Brazil
Date:	15/10/13

Each International Coordinator must send a version of this form to the STIC-AmSud Secretariat (sticamsud@conicyt.cl). At this stage of the project, we do not expect yet consolidated scientific results. We expect you to detail how you started the project and the collaborative actions you realized, and also to detail accordingly your budget demands for the second year. The development and execution of the projects will be evaluated by the Board of Directors and the Scientific Committee. The reception of this form, followed by the evaluation, is a condition for the renovation of funds for the next period.

	Institution	Name of the National Coordinator	E mail
French Partner A	Université d'Avignon	P. Michelon	philippe.michelon@univ-avignon.fr
French Partner B	Université de Versailles – St Quentin	T.Mautor	thierry.mautor@prism.uvsq.fr
South American Partner A	Universidade Federal do Ceará	Manoel Campêlo	mcampelo@lia.ufc.br
South American Partner B	Universidad Nacional de General Sarmiento	Javier Marenco	jmarenco@ungs.edu.ar
South American Partner C	Universidad de Concepción	Lorena Pradenas Rojas	lpradena@udec.cl
South American Partner D	Universidad de Santiago de Chile	Victor Parada Daza	victor.parada@usach.cl

Funds from funding agencies (in euros)			
Name of the agency[1]	Funds received 2013	Used funds (2013)[2]	Funds requested for 2014
CNRS	€ 2.500,00	€ 1.790,55	€ 2750 + € 709,45***
MAEE	€ 4.000,00	€ 3.297,94*	€ 7500 + € 702,06***
CAPES **	€ 8.550,00	€ 6.218,24*	€ 7250 + € 2331,76***
CONICYT	€ 4.525,00	€ 4.440,00*	€ 6750
MINCYT	€ 4.500,00	€ 2.516,00*	€ 3150 + € 1984,00***

(*) Including visits in November/2013 – tickets already bought.
(**) exchange rate 1EUR = 2.73 BRL (as used in the project)
(***) balance of the first year

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[1] MAEE, CNRS, INRIA, Institut TELECOM, MINCYT, CAPES, CONICYT, CONACYT, CONCYTEC, ANII.

[2] Until the report's date

1. FINANCING EVALUATION

Detailed mission expenses during the informed period (2012)

The objective of STIC-AmSud Program is to help investigators participate in scientific missions as well as in seminars and congresses.

Investigator (name, institution, position[3])	Mission details Objective (workshop, seminar, etc.), place, dates and duration	Travelling Costs	Travel Allowance	TOTAL (euros)
Bertrand Le Cun (UVSQ, MCF)	Kickoff meeting, Fortaleza, april 2013, 10 Days	965.26	879.13	1844.39
Thierry Mautor (UVSQ, MCF Habilité)	Kickoff meeting, Fortaleza, april 2013, 12 days	825.29	1054.95	1880.24
Philippe Michelon (UAPV, Professor)	Work visit, advance on the Russian Dolls method for max stable problems, Msc Dissertation Committee, Fortaleza, 10 days	1266.73	879.13	2145.86
Víctor Parada, USACH, Chile Professor	Work visit, Initiating the collaboration, seminar, Versailles, November 2013, 15 days	1534	1650 (+ 381,21 of additional charges)	3565,21
Lorena Pradenas, UDEC, Chile Professor	Initial meeting in Fortaleza; mar 29 to april 7, 2013, 7 days.	557	615.35	1172.35
Rosa Medina, UDEC, Chile Professor	Initial meeting in Fortaleza; March 29 to april 7, 2013; 7 days.	516	615.35	1131.35
Rodrigo Linfati, UBB, Chile Professor	Job meeting in Buenos Aires; 8-21 Sep 2013; 14 days. Work on a coloring problem	408	450	858.00
Monica Braga UNGS, Argentina, PhD student	Job meeting and Conference X OPTIMA in Chile; oct 26 - nov 4; 10 days	318	1425	1743.00
Diego Delle Donne, UNGS, PhD Student	Mission Buenos Aires → Fortaleza. From March 27 to April 8, 2013. Kickoff Meeting and work visit on polytopesa and russian dolls	848	1054.95	1902.95
Manoel Campelo UFC, Brazil Professor	Mission Fortaleza → Buenos Aires. 04 a 13/Nov, 2013. Work visit on polyhedral studies and coloring	507.62 (+ 52.07insurance)	450.00	1009.69
Victor Campos UFC, Brazil Professor	Mission Fortaleza → Buenos Aires. 04 a 13/November 2013. Work visit on polyhedral studies and coloring	507.62 (+ 52.07insurance)	450.00	1009.69
TOTAL (euros) :				18262.73

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[3] Professor, Post-doctorate, PhD student….

2. SCIENTIFIC AND TECHNOLOGY VALORIZATION

2.1. List of publications related to the project (published, submitted, accepted, or in preparation mentioning the STIC-AmSud Program) :

Thank you for mentioning the names of the investigators involved in the project.

Co-authors who participates in the project are in bold and marked with *

Published/Accepted papers
- **M. Campêlo*,** K. Lima, P. Moura, Y. Wakabayashi. Polyhedral studies on the convex recoloring problem. Electronic Notes in Discrete Applied Math, Proceedings of LAGOS 2013, to appear.
- **M. Campêlo*,** P. Moura, **Marcio Santos***. On the representatives k-fold coloring polytope. Electronic Notes in Discrete Applied Math, Proceedings of LAGOS 2013, to appear. DOI: 10.1016/j.endm.2013.10.037
- **M. Campêlo*,** C.G. Huiban, **Rudini Sampaio*.** The Hardness of the Distance-d Flow Coloring Problem. In: Workshop on Distance Geometry and Applications, 2013, Manaus. Submitted to Operations Research Letters.
- **M. Campelo, V. Campos, D. Delle Donne,** and **J. Marenco**, Polyhedral studies of the Asymmetric Representatives formulation for vertex coloring problems. Proceedings of X OPTIMA/ VI REDM. To appear.

Papers in preparation
- **Ricardo Corrêa*, Diego Della Donne*, Bertand Le Cun*, Thierry Mautor*, Philippe Michelon*** " A bit-parralilism based Russian Doll Approach for the Maximum Stable Set Problem", to be submitted to Computers & Operations Research (will be submitted before the end of 2013)
- **Mónica Braga***, **Diego Delle Donne***, **Rodrigo Linfati*, Javier Marenco*.** A branch and cut approach for the maximum-impact coloring problem (in preparation).
- **D. Delle Donne*** and **J. Marenco***, Vertex coloring polytopes over trees and block graphs.*.

2.2. Participation in seminars and congresses (national and international) related to the project :

- Members of the project have organized two technical session (Satble Stes I and Stable Sets II) in the Conference X Optima/ VI REDM, Concepción- Chile, October 2013.

2.3. Dissertation/Thesis Supervisions
- Tatiane Fernandez..An application of stable sets to the problem of team formation with social-technical constraints. MSc. Dissertation. Supervision: **Manoel Campêlo***.and **Ana Silva *. *Other researchers of the team are working on this problem with a different approach.***
- **Wladimir Tavares Araújo***. Resolution Search applied to the max stable set problem..PhD Thesis. Supervision: **Manoel Campêlo*, Carlos Rodrigues***.and **Philippe Michelon*. *This student will stay 1 year in Avignon (supported by CAPES) under the supervision of Prof. Philippe Michelon. A "co-tutelle" agreement was established between UFC and UAPV.***
- ***Márcio Costa Santos****. Computational Experiments with implementations of sets by direct addressing and the maximum stable set problem. MSc Dissertation, defended in October, 2013. Supervisor: **Ricardo Corrêa**. Committee: **Manoel Campelo, Carlos Rodrigues, Philippe Michelon.**

2.4. Papers in subjects related to the project

- **V. Campos,** V. Chvatal, L. Devroye, P Taslakian. Transversals in Trees. Journal of Graph Theory, v. 73, p. 32-43, 2013.

- J. Araujo, V. **Campos***, F. Giroire, N. Nisse, L. Sampaio, R. Soares. On the hull number of some graph classes. Theoretical Computer Science, v. 475, p. 1-12, 2013.

- **Campos, Victor***, F. Havet**, Rudini Sampaio*, Ana Silva*** . Backbone colouring: Tree backbones with small diameter in planar graphs. Theoretical Computer Science, v. 487, p. 50-64, 2013.

- **V. Campos***, S. Klein**, Sampaio, Rudini, Ana Silva***. Fixed parameter algorithms for the cocoloring problem. Discrete Applied Mathematics, 2014.

- **V. Campos***, A. K. Maia ; N. A. Martins ; Sales, C. L. ; **Sampaio, Rudini***. Fixed parameter algorithms for restricted coloring problems. Annals of Operations Research, to appear.

- **V. Campos***, A. K. Maia, Sales, C. L, **Sampaio, Rudini***. Maximization Coloring Problems on graphs with few P4's. Discrete Applied Mathematics, to appear.

- **Campêlo, Manoel**; **Corrêa, Ricardo**; Moura, P.; **Santos, Marcio**. On optimal k-fold colorings of webs and antiwebs. Discrete Applied Mathematics, v. 161, p. 60-70, 2013.

- **M. Campêlo*,** C.G. Huiban, **Rudini Sampaio***, Y. Wakabayashi. On the Complexity of Solving or Approximating Convex Recoloring Problems. Lecture Notes in Computer Science Volume 7936, 2013, pp 614-625. DOI: 10.1007/978-3-642-38768-5_54

- **Campêlo, Manoel**; **Corrêa, Ricardo**; Carlos Diego Rodrigues, Eliezer de Paula Neto. Escalonamento de Tarefas com Restrições de Precedência e Custos de Execução e Comunicação Unitários. In. SBPO 2013, p1-10.

- **Campêlo, Manoel**; Fábio Carlos Dias, Rafael Andrade, Críston Souza. Problema de Árvore Geradora Mínima com Restrição de Grau Mínimo e Centrais Fixos. In. SBPO 2013, p1-10.

- **Pradenas*, L**., Garcés, J., Ferland, J., **Parada*, V**. Genotype-phenotype heuristic approaches for a cutting stock problem with circular patterns. *Engineering Applications of Artificial Intelligence*. DOI: 10.1016/j.engappai.2013.08.003.

- **Lorena Pradenas*** y Eliseo Melgarejo. EL GMSTP CON MEMÉTICO CELULAR, Actas de resúmenes X OPTIMA/ VI REDM, Concepción-Chile, Octubre de 2013.

- Catherine Vera y **Lorena Pradenas***. Montaje de cadenas de ADN. Uso de Grafos y Algoritmos, Actas de resúmenes X OPTIMA/ VI REDM, Concepción-Chile, Octubre de 2013.

- E. Malaguti, **R. Medina Durán*,** P. Toth *"A metaheuristic algorithm for a real world cutting problem"* EURO, 2013.

- **R. Linfati***, Algoritmos Heurísticos para el problema de Localización y Ruteo de Vehículos con Múltiples Depósitos y su aplicabilidad al problema de Ruteo de. Simposio Argentino de Investigación Operativa, Octubre de 2013.

- I. Cartes, **R. Medina***, Estado del arte y modelamiento del problema de programación de cirugías electivas", Memoria de Titulo Ingeniero (in preparation).

- Bonomo F., **Delle Donne D.**, Durán G., and **Marenco J.**, Automatic dwelling segmentation of Buenos Aires Province for the 2010 Argentinian Census. Interfaces 43-4 (2013) 373-384.

- **Marenco J**. and Tetzlaff T., Envy-free division of discrete cakes. Discrete Applied Mathematics (in press).

- Acosta G., Caridi I., **Guala S**. and **Marenco J**., The quasi-periodicity of the minority game revisited. Physica A (in press).

- Durán G., **Marenco J.**, Romero G., and Weintraub A., An approach for efficient ship routing. International Transactions in Operational Research (in press).

- Bravo F., Durán G., Lucena A., **Marenco J.,** Morán D., y Weintraub A., Mathematical models for optimizing production chain planning in salmon farming. International Transactions in Operational Research (in press).

3. REQUESTED FUNDS FOR THE NEXT EXECUTING YEAR

Detail of the foreseen missions (2014)
YEAR N°2

Investigator (name, institution, position)	Mission details Objective (workshop, seminar, etc.), place, dates and duration	Travelling Costs	Travel Allowance	TOTAL (euros)
Funds for 2014				
Lorena Pradenas, UDEC, Chile Professor	Job meeting (Avignon, 15 days) and IFORS Conference (Barcelona 5 days)	1500	1500	3000
Rodrigo Linfati, UBB, Chile *OR* Rosa Medina UDEC, Chile Professor	Job meeting (Fortaleza, 10 days)	1000	950	1950
Víctor Parada, USACH, Chile, Professor	Job Meeting (Versailles, 15 days)	1400	1650	3050
Javier Marenco UNGS, Argentine Professor	Visit to work on coloring problems and polyhedral studies (Fortaleza, 15 days)	700	1425	2125
Marcelo Mydlarz UNGS, Argentine Professor	Visit to work on stable set aplications and solution methods (Avignon, 15 days)	1500	1500	3000
Manoel Campêlo UFC, Brazil Professor	Visit to work on coloring problems and polyhedral studies (B. Aires, 10 days)	700	950	1650
Fábio Dias UFC, Brazil PhD Student	Job meetung (Santiago, Concepción, 15 days)	700	1425	2125
Diego Rodrigues UFC, Brasil Professor	Visit to work on Resolution Search and co-supervision of PhD student (Avignon, 20 days)	1100	2000	3100
Serigne Gueye UAPV, Avignon Professor	Job meetung (Santiago, Concepción, 15 days)	1400	1425	2825
Philippe Michelon UAPV, Avigon Professor	Visit to work on Resolution Search and co-supervision of PhD student (Fortaleza, 13 days)	1100	1235	2335
Thierry Mautor UVSQ, Versailles Professor	Visit to work on Russian Dolls (Fortaleza, 12 days)	1100	1140	2240
TOTAL for 2nd year (euros) :				27400
Remaining Balance From 2013 – to be used in 2014				
Bertrand Le Cun (UVSQ, MCF)	Visit to work on the Social-technical team problem. Fortaleza, 7 days	910	615	1525
PhD Student UNGS, Argentine	Work visit – Social-technical tema problem, Fortaleza, 7 days	950	615	1565
Pablo Luiz PhD Student UFC, Brazil	Work visit - Coloring Problem, Avignon 5 days	1100	500	1600
Manoel Campelo UFC, Brazil	Extend the stay in B.Aires by 5 days	–	475	475
Remaining balance from 2013 (euros) :				5165
TOTAL for December/2013 and 2014 (euros) :				32565

4. ADDITIONAL INFORMATION

Thank you for including all other important information

Our project effectively started in April, 2013, after our Kickoff Meeting in Fortaleza. In that meeting, we divided the team into 5 work groups (see http://www.lia.ufc.br/sticamsud/groups.php for details). Each group has at least two members of each country, which helps to promote the collaboration. The groups have been working in their corresponding subjects since then and some progress have been made.

Group 1 - Social-technical team formation: Three approaches to this problem have been considered, based on different mathematical formulations proposed. The idea to compare their efficacy and to develop an efficient (maybe hybrid) solution method. A master student is involved in this group and is developing her dissertation in this subject. Her proposal will be defended in October, 2013.

Group 2 – Polyhedral studies in graph coloring: the first results obtained in this subject were submitted for X OPTIMA/VI REDM and accepted for publication. We used the representatives formulation of the coloring polytope to transform it into a stable set polytope of another graph. We then adapted properties of this latter polytope to get properties of the former. We also proved that if an optimization/separation problem for the coloring polytope can be polynomially solved, then the same stands for the representatives polytope associated to the Precoloring Extension problem. We are working to extending this results.

Group 3 – Stable sets pondered by subgraphs: we proposed an integer programming formulation together with some valid inequalities for this problem. All people working in this group is also working in other groups, where the efforts were firstly concentrated. In this second year more will be done in this subject.

Group 4 – Resolution Search: a first and basic version of the method has been implemented and tested on a very classical problem, the knapsack problem. This is a slight and unimportant change with respect to our initial plan, which was to test this first version on the Maximum Stable Set Problem. Besides this first code, the group got a deep understanding of the method. An exhaustive literature review has also been achieved. Several variations are currently under study. Some of them are suggested in the literature but some others are new, either suggested in the kickoff meeting or more recently. Most of these achievements are mainly due to a cotutelle thesis between the universities of Ceará and Avignon. We actually consider that a cotutelle thesis is by itself an important output of the project, since it ensures that the cooperation between the stakeholders will continue after the end of the project, even thought the corresponding publications should be ready also only after the end of the project. From now, we plan to implement the new ideas and variations as well as address links between Resolution Search and heuristic methods.

Group 5 – Russian Dolls Method: The algorithms to find a maximum stable set of a graph published in the last 10 years show that vertex covering, parallelism and ordering of the vertices have great influence in their performance. We have explored these ingredients into a Russian Dolls framework to get a new algorithm for the max stable set problem. Computational experiments with this algorithm is part of a Master dissertation defended by Marcio Costa Santos, under the supervision of Prof. Ricardo Corrêa (October, 2013). Extended results, showing that the algorithm is clearly more efficient than the other ones from the literature, will be submitted for publication soon. The author of this paper includes 4 researchers of this project.

Other results – Some of us have also been working on other stable set problems, for example convex recoloring problems and flow coloring problems. Part of the results were obtained after before the project official start as well as the corresponding publications, as enumerated in Subsection 2.1.