**SOBRAPO**

# FOREWORD
## PESQUISA OPERACIONAL: A CELEBRATION TO MARK
## HORACIO HIDEKI YANASSE'S 60th BIRTHDAY

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Horacio Hideki Yanasse is a leading scientist and Professor in Operations Research for more than three decades. His achievements as a scientist in the area include deep and long lasting contributions to the theory and also to practical aspects of Operations Research.



Horacio Hideki Yanasse.

This special issue of *Pesquisa Operacional* is dedicated to his 60th birthday. We are pretty much honored by Professor Reinaldo Morabito's invitation to edit this special issue in honor to Horacio's contributions. Moreover, as his friends, colleagues and one of them a former student this article has a personal account view.

The editors of this special issue also express their gratitude to the invited authors of this issue, who kindly accepted our invitation to honor the celebration that marks Horacio's 60th birthday, with their relevant contribution.

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This special edition has seven invited papers, and the opening paper is *A Review of three decades of research on some Combinatorial Optimization Problems*, by Horacio Yanasse to whom it is a pleasure to honor his 60th birthday.

The second paper: *Design to learn: customizing services when the future matters* by Dan Ariely, Gabriel Bitran and Paulo Rocha e Oliveira, from Duke, MIT and Iese brings Operations Research techniques applied to decision making when there is a huge amount of data available and the quality of information is essential.

The third paper: *A non-standard optimal control problem arising in an economics application*, by Alan Zinober and Suliadi Sufahani from Sheffield University show a solution non-standard optimal control problem from economics. It is also given under which conditions the optimal solutions can be achieved.

The fourth paper: *Using Value-Focused Thinking in Brazil* by Danielle Morais, Luciana Alencar, Ana Paula Costa and Ralp Keeney from UFPE and Duke uses Value-Focused Thinking (VFT) to structure three different Brazilian decision problems.

The fifth paper: *Ten years of research on Parametric Data Envelopment Analysis* (DEA) by Armando Milioni and Luciene Alves from ITA brings a conceptual research's ideas on Parametric Data Envelopment Analysis of the last ten years.

The sixth paper: *Clustering Search*, by Alexandre Oliveira, Antonio Chaves and Luiz Lorena from INPE present a new hybrid metaheuristic based on Clustering Search.

The seventh paper: *Some results about the connectivity of Trees*, by Lilian Markenzon, Nair Abreu and Luciana Lee from UFRJ and UFMT present a new graph invariant in the study of trees connectivity.

It is a strenuous task any attempt to summarize the scientific achievements of a world-class researcher that is also a recognized educator. Such task becomes bolder if this person has a humble perspective in relation to his many good deeds, deep and percipient mind and at the same time has a scientific approach that follows Gauss' motto "*Pauca sed matura* ".

In this text we bring a personal presentation of Professor Horacio Hideki Yanasse's career to celebrate his 60th birthday.

Horacio is currently Full Professor at the Universidade Federal de São Paulo (UNIFESP – São José dos Campos) and former Researcher at the National Institute for Space Research (INPE/LAC), where he still collaborates in the Graduate Program.

Horacio Hideki Yanasse was born in São Paulo-SP in June the 23rd 1952. He holds a BSc degree in Electronics Engineering from ITA – Instituto Tecnológico de Aeronáutica, 1974, with Honors from the Departments of Mathematics, Chemistry and Physics. He obtained his Master of Science from INPE – Instituto Nacional de Pesquisas Espaciais in 1977, with a dissertation entitled "Modelos e o método científico" under the supervision of José Alberto Costacurta de Azevedo. He is Doctor of Philosophy, area Operations Research, from MIT – Massachusetts Institute of

Technology, Sloan School of Management in 1981 under the supervision of professor Gabriel R. Bitran with a thesis entitled "Aggregation and computational complexity of lot size problems". He spent a sabbatical period, 1988-1989 and another two years, 1990-1991 as Associate Research at Applied and Computational Mathematics Department at Sheffield University with professor Alan Solon Ivor Zinober. In 1992 he spent a period as Visiting Professor at Tsukuba University with professor Hitasoshi Suzuki. In 2011 he got the Livre-Docênciatitle in Operations Research at Science and Technology Institute of Universidade Federal de São Paulo in São José dos Campos.

Horacio has hold relevant positions at INPE, where he entered in 1975 and from where he just retired. He was the Head of the Associated Laboratory for Computing and Applied Mathematics (Laboratório Associado de Computação e Matemática Aplicada) from 1995 to 2001. Later on he was the Head of the Space Engineering and Technology ETE (Coordenação de Engenharias e Tecnologia Espacial) from 2002 to 2006. From 2007 to 2011 he was the Coordinator of the Applied Computing Graduate Program.

His contributions to the Operations Research Societies area are also very relevants, since he was President of ALIO Latin-Ibero-American Association of Operations Research – (Associação Latino-Ibero-Americana de Pesquisa Operacional), from 2002 to 2004. Vice-President of IFORS (International Federation of the Operations Research Societies) from 2007 to 2009. Currently he is President of the Operations Research Society – SOBRAPO (Sociedade Brasileira de Pesquisa Operacional) from 2011.

Horacio also participated in many high level committees in Brazil. At CAPES – Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Coordination for the Improvement of Higher Education Personnel) he served as consultant to the Interdisciplinary and Engineering areas. At CNPq – Conselho Nacional de Desenvolvimento Científico e Tecnológico (National Council for Scientific and Technological Development) he served as consultant and currently coordinates the Industrial Engineering and Transportation Science area.

Since the beginning of this year he assumed a chair (upon a high-level peered exam) in Operations Research as Full Professor at Universidade Federal de São Paulo (UNIFESP) in São José dos Campos.

In the following paragraphs we outline some of his relevant scientific achievements. They provide just a glimpse of his many deep and percipient research in the view of these authors.

We present just two personal accounts of Horacio's scientific researches since many of the major ideas of his work we had opportunity to discuss and follow their development as they occurred to him and to the researchers that were working with him at that time. We observe that some of the studies did not generate articles but composed a platform for further works. Also, some of the studies generated many refereed articles, but our intention here is to give just a general and broad view.

To Integer Programming he and his students worked with Gomory's cuts; the Simplex Method; Dantzig-Wolf and Bender's decompositions, still in the beginning of the 80's. In special, to the Gomory's cuts and Simplex Method an idea was to try to detect integer points in objective function provided that the Integer Linear space was satisfied. If no integer point could be found then, preserving feasibility, the value of the objective function was diminished and the process repeated again. Albeit that idea was not considered further due to computational requirements of time and space (at that time) it gave an idea of the structure of the Integer Linear Programming feasible space.

As a natural consequence of these studies, the next attempt was directed towards Aggregation Methods, that is, to transform the set of integer linear constraints into a single one. That theme was, and still is, a challenge, since it is well known that a set of integer linear constraints can be transformed into a single one, it seems that it is not possible to maintain the coefficients "small" and to derive the single constraint in polynomial time in the size of the original set of constraints.

The research led into a new direction after considering the Knapsack Problem with no explicit bounds in the non-negative variables (KPU).The idea came after representing the single constraint in terms of a generating function and a solution being derived from the convolution of power series. A direct approach could not generate a competitive algorithm since even by using DFT's the running time is larger than Bellman's Dynamic Programming. Observe that the running time of the direct implementation of Discrete Fourier Transform to the problem is bounded by $O(nWlgW)$ and Bellman's by $O(nW)$ time and space, where $n$ is the number of variables and $W$ is the maximum input size. An interesting idea came after combining the generating functions approach with the lexicon-dominance of state values. With this implementation it was possible to diminish the space requirements from $O(nW)$ to $O(n + W)$ in memory and in time from $O(nW)$ to $O(n(W - \underline{w}))$, where $\underline{w}$ is the minimum input size. There is a clear gain in terms of space requirements.

He focused from 1990 onwards a Scheduling Problem – MOSP (Minimization of Open Stacks Problem). Horacio is one of the most prominent researchers dealing with this problem. The problem is usually given as a list of products composed each one by a set of pieces. The products have to be processed by a single machine that cutsthem. Equal pieces that appear in different products form a single stack. A stack is opened when the first piece of a product is cut and it is closed only after the last piece of usually another product is considered. It is assumed implicitly that there is no enough space around the machine to place all stacks. The objective is to minimize the maximum number of different pieces that at any moment are in the vicinity of the machine. The problem appears in a variety of different settings and at the time he was faced with a practical industrial case of cutting large wood plates.

To the formulation of the problem it has as input a matrix of products and pieces. Almost all approaches, at the time, to solve the problem examined directly that input matrix. Horacio introduced a new and non-trivial mathematical formulation to model MOSP. The idea he had was to transform that matrix into a graph, but the problem is how to generate it. What can be defined as the vertices and what about the edges? At first sight it seems that there is no gain to

the insight of problem's structure with this approach. In the Horacio's formulation a product is a clique that has as its vertices the pieces. Moreover, multiple edges are considered as a single one. This formulation is known today as a MOSP graph and with this idea he opened a new line of investigation to the problem. Based on that formulation he presented a large quantity of cases that the MOSP could be solved in polynomial time. Also, since the graph is composed by a set of cliques, the maximal one gives a lower bound to the problem. Later on, Linhares and Horacio could prove that MOSP is a NP-Hard problem. We note that their reduction was not derived from the hardness of the maximal clique problem.

Our personal comments on Horacio's works to the MOSP stops here, although we should remind that he continued and continues to work on it, with many interesting results published in refereed journals.

At the end of this forward we present the impact of Horacio's first indexed article with professor Bitran. Instead of given a brief summary of their idea we show the long standing influence that it exerted on the Lot Sizing Problem and to Computational Complexity analysis.

The Figure 1 presents the citations received by the first published article of Horacio, Bitran and Yanasse (1982), *Computational Complexity of the Capacitated Lot Size Problem* has been cited by a large quantity of articles all over the world. The data used by the next two figures were obtained by SUCUPIRA, Alves, Yanasse and Soma (2011), from Lattes Platform and from the ISI Web of Science for the citations. The diameter of each disk is proportional to the citations volume received by that paper.
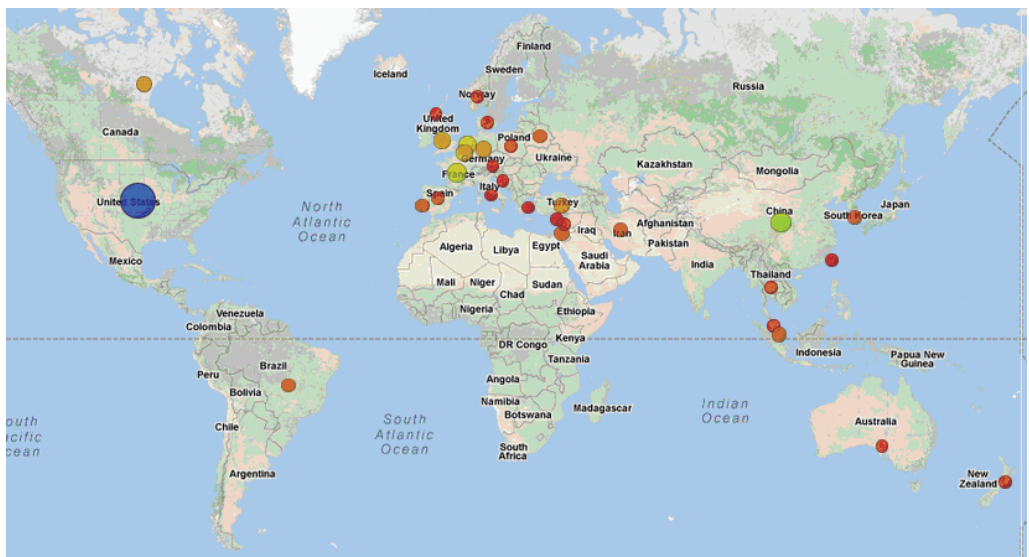


**Figure 1** – Bitran & Yanasse (1982) citations. Source: Web of Science, CV Lattes with the map generated with GPS Visualizer.

The Figure 2 gives the total of citations received by Horacio's papers indexed at the Web of Science. We observe that the impact of his ideas throughout the years cover all continents. It is important to observe that self-citations were not considered. Moreover, that the three largest quantity of citations of Horacio's work come from the US, France and China.
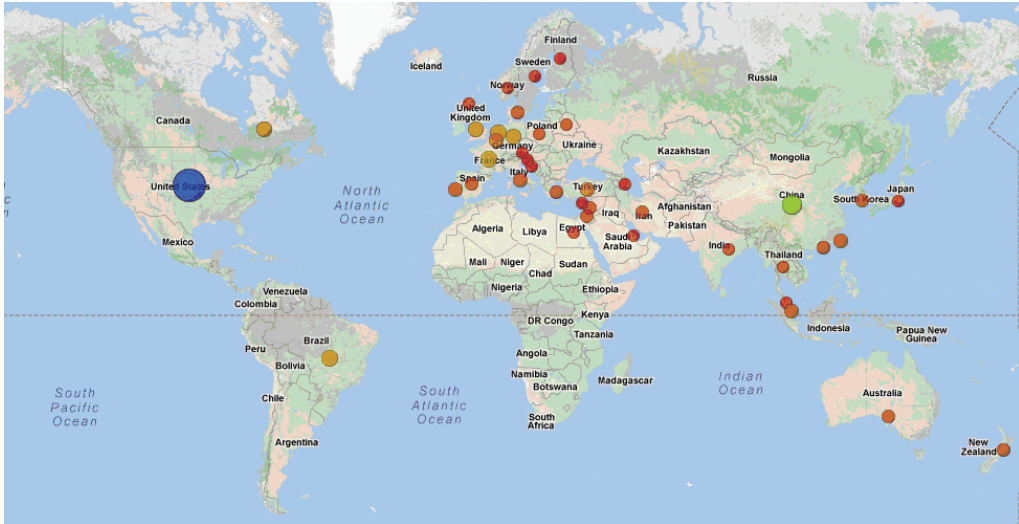


**Figure 2** – Horacio's papers citations. Source: Web of Science, map generated with GPS Visualizer.

We conclude this short presentation of Horacio's achievements with his students that met to a photo in front of INPE. Also some of then could not attend the meeting but sent us their photos.



**Students and Former Students** – Nei, Alexandre, Maria José, Daniel, Felipe, Rodolfo and Daniel.
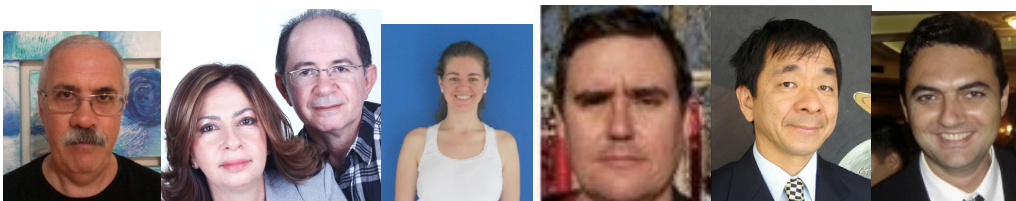


**Students and Former Students** – Becceneri, Iram and Iamara, Andreza, Rodrigo, Celso and Alexandre.

**Family** – Horacio, Lara and Rita.

We could not finish this brief text without presenting those who are always at Horacio's side: his family.



**Family** – Lara and Ricardo;                    Denise, Lara and Eduardo

## ACKNOWLEDGMENTS

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