CIO 2019

13th International Conference on Industrial Engineering and Industrial Management

XXIII Congreso de Ingeniería de Organización

Organizational Engineering in Industry 4.0

BOOK OF ABSTRACTS

Gijón, 11th-12th July 2019

Book of Abstracts

“13th International Conference on Industrial Engineering and Industrial Management” and “XXIII Congreso de Ingeniería de Organización (CIO2019)”

Book of Abstracts

“13th International Conference on Industrial Engineering and Industrial Management” and “XXIII Congreso de Ingeniería de Organización (CIO2019)”

<u>**COORDINADORES**</u>

DAVID DE LA FUENTE GARCÍA

RAÚL PINO DIEZ

PAOLO PRIORE

FCO. JAVIER PUENTE GARCÍA

ALBERTO GÓMEZ GÓMEZ

JOSÉ PARREÑO FERNANDEZ

ISABEL FERNÁNDEZ QUESADA

NAZARIO GARCÍA FERNÁNDEZ

RAFAEL ROSILLO CAMBLOR

BORJA PONTE BLANCO

Servicio de Publicaciones de la Universidad de Oviedo
Campus de Humanidades. Edificio de Servicios. 33011 Oviedo (Asturias)
Tel. 985 10 95 03 Fax 985 10 95 07
http: www.uniovi.es/publicaciones
servipub@uniovi.es

I.S.B.N.: 978-84-17445-38-6
DL AS 1875-2019

Imprime: Servicio de Publicaciones. Universidad de Oviedo

13th International Conference on Industrial Engineering and Industrial Management
XXIII Congreso de Ingeniería de Organización
Gijón, Spain, July 11-12, 2019

Systematic Literature Review on symmetry breaking option on mathematical programming models for planning problem with rolling horizon procedures

Rius-Sorolla G[20], Maheut J, Estellés-Miguel S, García-Sabater JP

Keywords: Supply Chain Management; Rolling Horizons; Symmetry; Mixed Integer Lin-ear Programming;

1 Introduction

The rolling horizons procedure is a common tool in the operations planning in industry and in academic environments. Its use helps to make decisions in environments of uncertainty and at the same time simplify big problems in small planning horizons. But it is a heuristic method, where it should be said that the best planning operations proposals that are obtained on each rolling horizon are not necessarily the same planning operations proposal that would be found in the solution of the entire time horizon.

The rolling horizons are an accurate representation of the industrial. Companies must make decisions about the operations planning from orders and forecasts, their current situation and the available capacity. In the following period, an update information is usually available together with the results of the planned planning. The new information may have variations within the expected ranges, or totally unexpected (require contingency plans for accidents or catastrophes) or higher than forecast ranges but expected (reactive plan in real time together with preventive actions). This new information allows updating the planning for the following periods, by modifying the previous plan or launching a new planning recalculation**.** In the industry, the companies recalculate their planning according to information update, although they try not to make changes in the near periods, in order to reduce the nervousness or planning instability and costs (Sahin et al., 2013), given that the competitiveness of the company lies in the balance between its ability to react to changes and its operating costs.

---

[20]e-mail: greriuso@upv.es Dpto. de Organización de Empresas. Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia.

A particularity of these problems is that symmetries frequently appear in mathematical programming models. That is, different equivalent or equal elements generate alternative solutions with similar results in the objective function. Variables that can be exchanged without changing the structure of the problem (Alemany et al., 2014). These symmetries slow down the search algorithms of the best solution to the objective function that complies with the modelling constraints. Equivalent solutions can be exchanged, where different solutions are proposed for the same objective value. This may make it more difficult to demonstrate the optimality of the problem solutions and, therefore, increase the computation time. Jans (2009) showed that eliminating the symmetry of the formulation can be useful to accelerate computational times.

The symmetry in the mathematical programming models is especially relevant when the procedure of the rolling horizons is applied. The proposed solutions to the models, within the allowed tolerance or calculation time, can vary from one computer equipment to another. These different solutions can involve large differences in the following planning horizons in the rolling horizons procedure.

To the best of our knowledge we have not found a review of the literature on the treatment of symmetry when using the rolling horizons procedure. Therefore, a systematic review of the literature on measures to avoid symmetry in models with the rolling horizons procedure is proposed.

5 Conclusion

The complete work presents the results of a systematic literature review on actions to break the symmetry in models that apply rolling horizons procedure.

It is highlighted the importance of breaking symmetry in order to avoid unwanted solutions or speed up the resolution process. The identified symmetries focus on demands related to equivalent products and operations that can be performed on equivalent resources. Extrapolating the symmetries to the indexes of a mathematical programming model for planning (Rius-Sorolla et al., 2018), it has been identified products, resources, operations and time but not the time relative index.

References

Alemany, J., Magnago, F., Moitre, D., & Pinto, H. (2014). Symmetry issues in mixed integer programming based Unit Commitment. *International Journal of Electrical Power and Energy Systems*, *54*, 86–90. https://doi.org/10.1016/j.ijepes.2013.06.034

Jans, R. (2009). Solving lot-sizing problems on parallel identical machines using symmetry-breaking constraints. *INFORMS Journal on Computing*, *21*(1), 123–136.

Rius-Sorolla, G., Maheut, J., Coronado-Hernandez, J. R., & Garcia-Sabater, J. P. (2018). Lagrangian relaxation of the generic materials and operations planning model. *Central European Journal of Operations Research*. https://doi.org/10.1007/s10100-018-0593-0