# CD06

## *Operations Research Models*

## Modelos de Investigación Operativa

*Organizers* **Organizadores** **Antolatzaileak**

**Paula Segura Martínez**
(Universitat Politècnica de València)

**Laura Davila Pena**
(University of Kent)

**Francisco Temprano García**
(Universidad de Sevilla)

*Description* **Descripción** **Deskribapena**

***Operations research is a mathematical discipline in which advanced analytical techniques are developed and used to solve problems and facilitate decision making. Areas such as logistics, resource planning or supply chain management, among others, where it is common to seek the maximum of a profit or the minimum of a risk, can be treated from the perspective of operations research. The development of efficient mathematical models that explain and describe the needs of these systems is essential to find the best solution to a problem from a set of possible options, taking into account the constraints and objectives in question. In this session, young researchers will present their most recent advances in this field.***

La investigación operativa (IO) es una disciplina matemática en la que se desarrollan y utilizan técnicas analíticas avanzadas para resolver problemas y facilitar la toma de decisiones. Áreas como logística, planificación de recursos o gestión de cadenas de suministro, donde es común buscar el máximo de una ganancia o el mínimo de un riesgo, pueden ser tratadas desde la perspectiva de la IO. El desarrollo de modelos matemáticos eficientes que expliquen y describan las necesidades de estos sistemas resulta imprescindible para encontrar la mejor solución a un problema a partir de un conjunto de opciones posibles, teniendo en cuenta las restricciones y los objetivos en cuestión. En esta sesión, se presentarán avances recientes en este área.

*MSC Codes* **Códigos MSC** **MSC Kodeak**

90Cxx

(primary)

*Slots* **Bloques** **Blokeak**

1.A (Aula 0.17); 1.B (Aula 0.17); 2.C (Aula 0.17)

*QR Code* **Código QR** **QR Kodea**

*Session Schedule* **Horario de la Sesión** **Saioaren Ordutegia**

L13 | 17:30-17:50 | 0.17
***An Integrated Network Design Model for a Transportation Problem***
**Natividad González-Blanco** (Universidad Loyola & Universidad de Sevilla)

L13 | 18:00-18:20 | 0.17
***Integrated Schedule Planning for Regional Airlines Using Column Generation***
**Alberto Santini** (Universitat Pompeu Fabra)

L13 | 18:30-18:50 | 0.17
***A time space network model for a truck and drones delivery system***
**Carlos Valverde** (University of Seville)

L13 | 19:00-19:20 | 0.17
***Solving the Chinese postman problem with load-dependent costs***
**Paula Segura Martínez** (Universidad de Valencia)

M14 | 15:00-15:20 | 0.17
***A MILP for the Robotic Disassembly Sequence Planning Problem***
**Miguel Reula** (Universitat de Valencia)

M14 | 15:30-15:50 | 0.17
*Mathematical Optimization for Computing the Growth of Chemical Systems*
**Gabriel González Domínguez** (Universidad de Granada)

M14 | 16:00-16:20 | 0.17
*The Fesenthal Power Index for simple games with a priori unions*
**Alicia Mascareñas Pazos** (Universidade de A Coruña)

M14 | 16:30-16:50 | 0.17
*A novel view of exponential sets of constraints*
**Francisco Temprano García** (Universidad de Sevilla)

| *Monday 13* | **Lunes 13** | **Astelehena 13** |
|---|---|---|
| *17:30-17:50* | **17:30-17:50** | **17:30-17:50** |
| *[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]** |

***An Integrated Network Design Model for a Transportation Problem***

**Natividad González-Blanco**
(Universidad Loyola & Universidad de Sevilla)

Awareness of traffic congestion and environmental issues has promoted public transit worldwide. When a new rapid transit line is built, the slow mode—usually buses covering existing demand—must be canceled or modified, leading to suboptimal solutions. Therefore, we consider an integrated model to design rapid and slow networks simultaneously, aiming to maximize the demand captured by both modes. We present a mathematical formulation solved using an improved Benders decomposition.

Joint work with Antonio J. Lozano, Vladimir Marianov and Juan A. Mesa.

| *Monday 13* | **Lunes 13** | **Astelehena 13** |
|---|---|---|
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***Integrated Schedule Planning for Regional Airlines Using Column Generation***

**Alberto Santini**
(Universitat Pompeu Fabra)

We simultaneously optimise medium-term airline schedule planning decisions (frequency planning, timetable design, fleet assignment, and limited route selection) for regional feeder airlines. We exploit a tight exponential-size formulation to obtain gaps under 0.2 % within minutes.

Joint work with Vikrant Vaze.

| *Monday 13* | **Lunes 13** | **Astelehena 13** |
|---|---|---|
| *18:30-18:50* | **18:30-18:50** | **18:30-18:50** |
| *[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]** |

***A time space network model for a truck and drones delivery system***

**Carlos Valverde**
(University of Seville)

We present a multiperiod mixed-integer quadratic programming formulation for a delivery problem involving a mothership and drones. The mothership can only stop at designated parking locations, separate from customer sites. During these stops, drones deliver packages at varying speeds. The formulation integrates mothership routing, drone scheduling, and battery charging cycles. A matheuristic algorithm is developed and validated through a case study in Rome with up to 200 customers, supported by extensive computational results on a large testbed.

Joint work with Lavinia Amorosi, Paolo Dell'Olmo and Justo Puerto.

| *Monday 13* | **Lunes 13** | **Astelehena 13** |
|---|---|---|
| *19:00-19:20* | **19:00-19:20** | **19:00-19:20** |
| *[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]** |

***Solving the Chinese postman problem with load-dependent costs***

**Paula Segura Martínez**
(Universidad de Valencia)

In this talk, we summarize two mathematical programming formulations proposed in the literature for the Chinese Postman Problem with load-dependent costs, reviewing the strengths and drawbacks of each of them, and present a new mixed-integer linear programming formulation for the problem, proposing some families of valid inequalities to reinforce this formulation. The computational results obtained with a new branch-and-cut algorithm are compared with those already existing in the literature.

Joint work with Isaac Plana and José María Sanchis.

| *Tuesday 14* | **Martes 14** | **Asteartea 14** |
|---|---|---|
| *15:00-15:20* | **15:00-15:20** | **15:00-15:20** |
| *[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]** |

*A MILP for the Robotic Disassembly Sequence Planning Problem*

**Miguel Reula**
(Universitat de Valencia)

Maximizing the benefits of remanufacturing requires efficient reuse of components from end-of-life (EoL) products. This work presents a MILP model to design the robotic disassembly process for EoL products, optimizing economic performance and environmental compliance. The model is able to identify the optimal disassembly level, disassembly sequence, and component recovery options. Two case studies on gear pumps validate the model, offering insights into recovery strategies.

Joint work with Consuelo Parreño-Torres and F. Javier Ramírez.

| *Tuesday 14* | **Martes 14** | **Asteartea 14** |
|---|---|---|
| *15:30-15:50* | **15:30-15:50** | **15:30-15:50** |
| *[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]** |

*Mathematical Optimization for Computing the Growth of Chemical Systems*

**Gabriel González Domínguez**
(Universidad de Granada)

This work presents a novel optimization framework for computing the growth factor of autocatalytic subnetworks in chemical reaction networks (CRNs). By formalizing CRNs with stoichiometric matrices and developing mixed-integer programming models, we capture the structure of autocatalytic subnetworks. This approach offers insights into the role of autocatalysis in complex systems, advancing our understanding of the chemical foundations of life and related applications.

Joint work with Víctor Blanco and Praful Gagrani.

*Tuesday 14* | **Martes 14** | **Asteartea 14**
*16:00-16:20* | **16:00-16:20** | **16:00-16:20**
*[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]**

***The Fesenthal Power Index for simple games with a priori unions***

**Alicia Mascareñas Pazos**
(Universidade de A Coruña)

In game theory, simple games are often used to model collective decision-making. Power indices measure a player's ability to influence the final result, i.e., to form part of a winning coalition. Fesenthal introduced a new index based on the formation of winning coalitions of least size. We generalize the definition of the Fesenthal index taking into account certain affinities that might exist between players, and obtain an axiomatic characterization for this new power index.

Joint work with S. Lorenzo-Freire and J.M. Alonso-Meijide.

*Tuesday 14* | **Martes 14** | **Asteartea 14**
*16:30-16:50* | **16:30-16:50** | **16:30-16:50**
*[Room 0.17]* | **[Aula 0.17]** | **[Gela 0.17]**

***A novel view of exponential sets of constraints***

**Francisco Temprano García**
(Universidad de Sevilla)

In this talk, we present interesting properties and structures that can be exploited in our advantages when analyzing an optimization combinatorial problem. Specifically, we refer to families of constraints or valid inequalities whose sizes are exponential. Exponential number of constraints and variables normally provides a better description of the problem polytope. That is why it is worth studying this kind of models to try to give a detailed description of its convex hull.

Joint work with Ivana Ljubic, Alfredo Marín, and Justo Puerto.