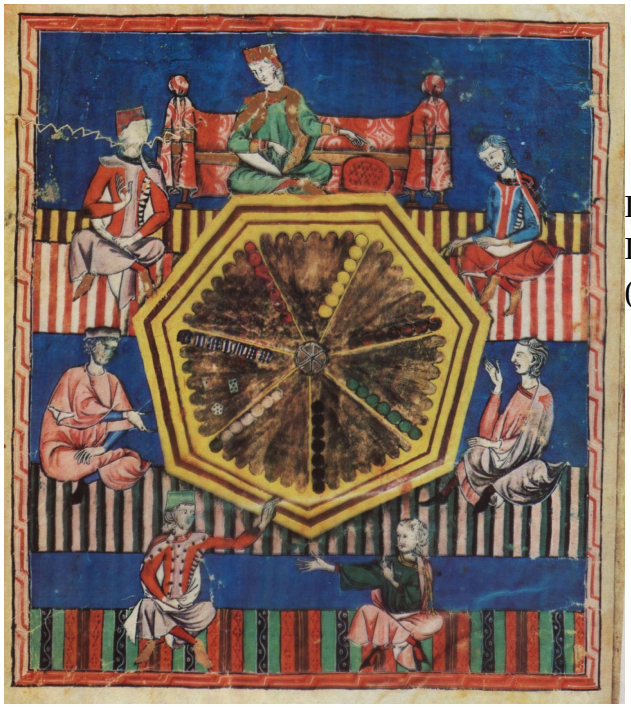
PROGRAM

Workshop on Game Theory and optimization in honor of Guiomar Martín-Herrán



Libro de los juegos de Ajedrez, Dados y Tablas. Alfonso X el Sabio (1221-1284), Sevilla, 1283

Sunday July 20th		Monday July 21st		Tuesday July 22nd	
		8:45-9:15	Registration		
		9:15-9:30	Welcome address	9:30-10:30	Session 5
		9:30-11:00	Session 1	10:30-11:30	Special Session
		11:00-11:30	Coffee Break	11:30-12:00	Coffee Break
		11:30:13:00	Session 2	12:00-13:00	Session 6
		13:00-14:30	Lunch	13:00-14:30	**Lunch & Farewell**
		14:30-16:00	Session 3		
		16:00-16:30	Coffee Break		
		16:30-17:30	Session 4		
20:00	**Welcome cocktail**	20:30-	**Conference Dinner**		

Venue

Instituto de estudios europeos, Universidad de Valladolid

Plaza de Santa Cruz, 5 | 1ª planta
47002 VALLADOLID (Spain)

Monday July 21st	
8:45-9:15	Registration
9:15-9:30	Welcome address
9:30-11:00	*Session 1 (Jesús Marin Solano)*
9:30-10:00	*Non-deceptive counterfeiting with brand dilution and network externalities: Beyond conventional beliefs* Salma Karray and **Simon Pierre Sigue**.
10:00-10:30	*Peer-to-Peer Sharing, Price Competition, and Consumers' Awareness* Francisco J. André, **Carmen Arguedas**, Claudia Ranocchia and Sandra Rousseau
10:30-11:00	*On the robustness of coalition stability in the great fish war model* Julia de Frutos Cachorro, Carles Mañó-Cabello and **Jesús Marín-Solano**
11:00-11:30	Coffee Break
11:30-13:00	*Session 2 (María Pilar Martıínez-García)*
11:30-12:00	*Conjectural learning in a groundwater exploitation problem* Alain Jean-Marie, **Mabel Tidball** and Tania Jiménez
12:00-12:30	*Farmers' Adaptive Investments and Groundwater Resource Impact in a Changing Climate.* **Julia de Frutos Cachorro** and Lucia Sbragia
12:30-13:00	*Productivity, growth and the geography of pollution regulation* **María Pilar Martıínez-García** and José R Morales
13:00-14:30	Lunch
14:30-16:00	*Session 3 (Georges Zaccour)*
14:30-15:00	*Collusion for the Climate? A Welfare Analysis of Green Antitrust in a Regulated Oligopoly* Francisco Cabo and **Lucia Sbragia**
15:00-15:30	*Climate Change, Endogenous Growth and Time-Inconsistency* **Carles Mañó-Cabello**
15:30-16:00	*Payment schemes for finitely repeated Prisoner's Dilemma games* Elena M. Parilina, Alena Pisareva , **Georges Zaccour**
16:00-16:30	*Coffee Break*
16:30-17:30	*Session 4 (Michèle Breton)*
16:30-17:00	*Exit and Pollution Regulation: A Dynamic Games Approach* **Bertrand Crettez** and Naila Hayek
17:00-17:30	*Ranking Quantilized Mean Field Games: Application to Early-Stage Venture Investments* **Michèle Breton**, Dena Firoozi and Rinel Foguen Tchuendom
20:30-	**Conference Dinner**

Tuesday July 22nd	
9:30-10:30	*Session 5 (Santiago J. Rubio)*
9:30-10:00	*Renewable natural resource management with nonconstant discounting* Jesús Marín-Solano and **Jorge Navas**
10:00-10:30	*Taxes vs. Subsidies with Technology Choice and Endogenous Market Stucture in the Presence of Environmental Aware Consumers* Begoña Casino, Luís M. Granero and **Santiago J. Rubio**
10:30-11:30	Special Session: **Guiomar Martín Herrán**
11:30-12:00	*Coffee Break*
12:00-13:00	*Session 6 (Francisco Cabo)*
12:00-12:30	*Multidimensional Chebyshev interpolation-based methods for differential game problems* **Víctor Gatón**, Carmelo de Castro and Beatriz Gómez-Martín
12:30-13:00	Environmental regulation and green reputation: tax evasion versus greenwashing **Francisco Cabo**, Guiomar Martín-Herrán and Laís Ramos
13:00-14:30	Lunch & Farewell

Abstracts

Monday, July 21st

Session 1: July 21st 9:30-10:00

Non-deceptive counterfeiting with brand dilution and network externalities: Beyond conventional beliefs

Salma Karray (Faculty of Business and IT, Ontario Tech University),
Simon Pierre Sigue (Faculty of Business, Athabasca University & Wits School of Business Sciences).

Non-deceptive counterfeiting involves producing and selling counterfeit products at lower prices without misleading consumers about their authenticity. This practice intensifies price competition for genuine brands while contributing to both brand dilution and network externalities. Using a game-theoretic approach, we analyze how manufacturers of genuine products should adjust their advertising and pricing strategies over time in response to counterfeiting. Our findings reveal that in the presence of network externalities, manufacturers should increase both advertising investments and prices to maximize profits. However, when brand dilution occurs, the optimal response depends on market conditions. In some cases, a survival strategy--reducing advertising and/or prices--may be necessary to maintain profitability, even at lower levels than in a monopoly. In other cases, a differentiation strategy--raising advertising and prices--can lead to profit gains. Regardless of the approach, manufacturers must enhance advertising effectiveness to strengthen brand differentiation, maintain competitiveness, and mitigate the negative effects of brand dilution.

Session 1: July 21st 10:00-10:30

Peer-to-Peer Sharing, Price Competition, and Consumers' Awareness

Francisco J. André (Dpt. Economic Analysis and ICAE, Universidad Complutense de Madrid),
Carmen Arguedas (Dpt. Economic Analysis, Universidad Autónoma de Madrid),
Claudia Ranocchia (Faculty of Economics and Business, Universidad Complutense de Madrid),
Sandra Rousseau (Faculty of Economics and Business, KU Leuven).

In this paper, we investigate the incentives of consumers and firms to take part in the circular economy. In the case of consumers, such participation takes the form of sharing goods instead of buying them only for their own use. In the case of firms, they can supply goods that are suitable to be shared in digital platforms (circular goods) rather tan standard goods. To this end, we present a model of product differentiation where two firms can offer either a standard or a circular version of a product. Consumers are heterogeneous concerning the proportion of time they use the good for themselves and can end up being either consumers of the standard variety, or prosumers or users of the circular variety. We characterize the Subgame Perfect equilibrium of the resulting game for a given degree of maturity of the sharing market, consumers' degree of heterogeneity regarding the intensity of use, marginal cost differences between the two varieties and whether consumers care for circularity. This last feature is key to our results. In the absence of environmental awareness, there is very little space for the circular product to coexist with a standard variety: the circular variety is more expensive, has a lower market share, and results in lower, albeit positive, profits. Things change dramatically if consumers experience bad conscience when purchasing the standard version: the circular product continues to be more expensive, but it may beat the standard variety in market share and profits. This can even result in both firms offering the circular variety in equilibrium. Our

findings suggest that consumers' environmental awareness is key to accelerating the transition towards the circular economy. We also investigate the effects of other important features in the circular transition, such as the degree of maturity of the sharing market or individuals' heterogeneity with respect to the amount of time they use the goods for themselves.

Session 1: July 21st 10:30-11:00

On the robustness of coalition stability in the great fish war model

Carles Mañó-Cabello (Department of Economics, KU Leuven),
Jesús Marín-Solano (Departament de Matemàtica econòmica, financera i actuarial and BEAT, Universitat de Barcelona).

Abstract: The Great Fish War model offers a parsimonious framework for analyzing the harvesting of fish from a common water territory under open access by multiple agents. In its classical formulation, the resource growth follows a power function, while players' instantaneous utilities are logarithmic. It is well established that the formation of stable coalitions within this setting is highly unlikely. Specifically, when players are symmetric and act simultaneously, the maximum stable coalition size is limited to two, and the criteria required for such stability are stringent. This paper investigates the robustness of this finding under alternative utility specifications. To facilitate analytical tractability, we approximate the original growth function using a piecewise linear function derived through linear interpolation.

Session 2: July 21st 11:30-12:00

Conjectural learning in a groundwater exploitation problem

Alain Jean-Marie (Inria, Univ Montpellier, Montpellier),
Mabel Tidball (CEE-M, Univ Montpellier, CNRS, Institut Agro, Montpellier),
Tania Jiménez (Universite d'Avignon).

In the context of dynamic games of renewable resource consumption, in which players have limited information, agents are constrained to rely on observation and some form of learning. Firstly, to address this lack of information, we assume that agents may form conjectures about their opponent's behaviour as a parameterized function of the current state of the environment and their own current action. Agents then adapt the parameters of these conjectures based on subsequent observations collected after each round of decisions and the evolution of the environment.
On the other hand, in the context of repeated interactions between economic agents and a resource and among themselves, an additional source of inefficiency arises from the imperfect consideration of the future. Agents may unwilling or unable to perform the complex calculations required for inter-temporal optimization over several periods of horizon. Instead, they could resort to a myopic optimization taking into only account the current situation and neglecting future actions and resource states. However, the dynamic programming principle, which applies to many optimization situations, suggests that the future of the system can be accounted for through a "scrap value" added to the agent's current profit. To take into account this imperfect perception of the inter-temporal process we endow the myopic agents with a certain degree of forward-looking behaviour.
We apply this modelling framework to a problem of groundwater exploitation where water extraction is the only input in the production process of farmers, and the dynamics are just the evolution of the level of the water table. We introduce a subjective valuation of the future in the form of a unit price parameter attached to the future level of the resource. Profits are specified using a quadratic function, which allows for the derivation of explicit formulas and convergence conditions for most of the learning processes.

Assuming players have complete information about their opponent's profit function, they can choose from among the infinite-horizon solutions. For the purpose of comparison with the learning process, we examine two standard solutions: the Nash feedback equilibrium and the cooperative (or "Pareto optimal") solution.
We conduct numerical experiments to assess the relative "performance" of the different complete-information and incomplete-information schemes we have specified. We evaluate behaviours using two metrics: total discounted profit and limit stock of the resource. The experiments show that when agents adopt a certain conjectural learning behaviour, their total profit can be comparable to the farsighted cooperative solution, and may even yield a higher asymptotic stock level. However, this result depends on the valuation agents place on future stock, which must be appropriately chosen. If this valuation is too small, the performance of these schemes is worse than that of the farsighted Nash solution, in terms of both profits and resource levels.

Session 2: July 21st 12:00-12:30

Farmers' Adaptive Investments and Groundwater Resource Impact in a Changing Climate.

Julia de Frutos Cachorro, (Departament de Matemàtica Econòmica, Financera i Actuarial and BEAT, Universitat de Barcelona),
Lucia Sbragia (Department of Economics, Durham University Business School).

One of the many effects of Climate Change is increased drought making water availability scarcer in more regions of the world, and primarily affecting the agricultural sector. In this context, we examine the effects of farmers' investments in adaptive measures as a response to climate change on the sustainability and profitability of the resource. To this goal, we develop a two-period model, where the impact of climate change impacts the availability of the groundwater resource in the second period and farmers respond to it by investing in solutions that reduce their marginal extraction costs. Theoretical results show that adaptive investments have different implications depending on the perspective considered. From a strict environmental standpoint, they are detrimental, as they lead to a lower final stock of the natural resource. From the farmers' perspective, adaptive investments are beneficial, as they allow for higher profits. Finally, from the regulator's standpoint, the impact depends on the weight given to sustainability concerns on the welfare function. Furthermore, in cases where adaptation negatively impacts the overall welfare and therefore policy intervention is justified, we assume that the regulator responds by imposing a tax on second-period extraction rates, thereby reducing the effectiveness of adaptive investments. After determining the optimal tax rate, we evaluate its impact by comparing the outcomes of the model with adaptation to those of the model with both adaptation and taxation. The results indicate that, from an environmental perspective, the tax is beneficial as it helps preserve a larger final resource stock. From the farmers' viewpoint, taxation is always detrimental. Finally, from the regulator's perspective, the impact is always positive given the sustainability concerns.

Session 2: July 21st 12:30-13:00

Productivity, growth and the geography of pollution regulation

Marıía Pilar Martínez-García (Department of Quantitative Methods for Economics and Business, University of Murcia),
José R Morales (Department of Quantitative Methods for Economics and Business, University of Murcia).

This paper develops a New Economic Geography model of two regions with polluting firms subject to regional abatement policies. Pollution reduces the welfare of the population. Firms exhibit different levels of productivity, with more productive firms emitting fewer emissions

per unit of output. Only the more productive firms can afford the fixed costs of producing, while the less productive ones exit the market. The model captures the strategic behavior between competing firms, its effect on their innovation decisions, and the resulting growth pattern. Environmental policy has two opposing welfare effects: it reduces nominal wages and improves environmental quality. It also raises production costs, which pushes less productive firms out of the market. Our model incorporates all the effects of Krugman's model but also introduces a pollution effect that works against firm agglomeration. Greater heterogeneity in firms' productivity weakens the agglomerative forces and increases the propensity to export. Firms' heterogeneity fosters the dispersion of the industry. This paper investigates the effect of the strategic behavior on firm heterogeneity and how environmental policy impacts on the geolocation of the most productive firms.

Session 3: July 21st 14:30-15:00

Collusion for the Climate? A Welfare Analysis of Green Antitrust in a Regulated Oligopoly

Francisco Cabo (IMUVa, Universidad de Valladolid),
Lucia Sbragia (Department of Economics, Durham University Business School).

The commitments undertaken by countries under the Paris Agreement (2016) require the implementation of effective measures to combat climate change, notably through the adoption of environmental policies aimed at fulfilling emission reduction targets. The economic implications of such policies remain a subject of scholarly debate. On one hand, environmental regulations have been perceived as imposing additional costs that may hinder firm competitiveness. On the other hand, environmental regulations can act as a catalyst for innovation, enabling firms to explore new markets and enhance their performance. Environmental policy thus introduces both opportunities for sustainable growth and challenges related to increased compliance burdens, with potential implications for firm competitiveness in both domestic and international markets. This paper explores whether green antitrust can serve as a viable policy instrument in addressing climate change. Specifically, we develop a vertically differentiated oligopoly model in which firms, as a by-product of their production activities, emit pollution that accumulates and causes an environmental damage— an externality that firms do not internalize. In contrast, a benevolent government internalizes this externality and imposes an environmental tax on emissions. Firms respond to this regulation by investing in emission abatement, and this is rewarded by consumers who are willing to pay a premium price related to any actions taken by firms concerning the environment. The model is structured as a three-stage game: in the first stage, the government sets the emission tax; in the second stage, firms decide on their abatement levels; and in the third stage, firms compete in quantities. We analyze four distinct scenarios: (1) a benchmark case without any collusion; (2) a scenario where firms collude only in output decisions; (3) a scenario where collusion occurs only in abatement levels; and (4) a scenario in which firms coordinate both quantity and abatement decisions. We evaluate the social welfare implications of each scenario, assessing whether certain forms of cooperation among firms— typically forbidden under antitrust law— may, under environmental regulation, yield socially desirable outcomes.

Session 3: July 21st 15:00-15:30

Climate Change, Endogenous Growth and Time-Inconsistency

Carles Mañó-Cabello (Department of Economics, KU Leuven).

Can being time inconsistent help with climate change? How does being time-inconsistent affect economic growth, the extraction of natural resources, pollution and temperature? In this paper we study an endogenous growth model of the expanding variety class, with exhaustible

natural resources and climate change under non-constant discounting. We study the naive agent case, who is time-inconsistent under a general discount function and tends to procrastinate. We compare the solutions obtained with a general discount function versus the canonical time-consistent exponential discounting. Both economic activity and the extraction of the resource generate pollution, which exacerbates climate change. We show that time-inconsistent agents with constant elasticity of intertemporal substitution (CEIS) lower (higher) than one have lower (higher) levels of economic growth, extract the resource more (less) aggressively, and experience lower (higher) growth rate of the creation of new ideas

Session 3: July 21st 15:30-16:00
Payment schemes for finitely repeated Prisoner's Dilemma games

Elena M. Parilina (Saint Petersburg State University, Saint Petersburg; Qingdao University, School of Mathematics and Statistics, Qingdao),
Alena Pisareva (Saint Petersburg State University, Saint Petersburg),
Georges Zaccour (Chair in Game Theory and Management, GERAD, HEC Montreal).

In the paper we consider finitely repeated Prisoner's Dilemma and propose the method of sustaining cooperation based on the ε-equilibrium in limited retaliation behavior strategies. The main feature of this strategy is that the punishment of a deviated player does not necessarily last until the end of the game. The duration of punishment depends on the stage when deviation happens and it is not uniquely defined. We propose two payment schemes along the cooperative trajectory to sustain cooperation based on limited retaliation strategies. If the payments in the game are organized following these schemes, when they exist, then players have no incentive to deviate and cooperation is sustainable against individual deviations. Keywords: Prisoner's Dilemma; Repeated Games; Limited Retaliation; Cooperation; Payment Schemes.

Session 4: July 21st 16:30-17:00
Exit and Pollution Regulation: A Dynamic Games Approach

Bertrand Crettez (Université Panthéon-Assas, Paris II, CRED),
Naila Hayek (Université Panthéon-Assas, Paris II, CRED).

We consider an industry with an evolving regulatory setting over time. During a first stage, there is a duopoly including a brown firm and a green firm. The brown firm produces a brown product (producing it causes polluting emissions). The green firm produces a green product (producing it causes minimal pollution). A second stage starts at a date announced by the regulator from the outset, after which the brown product cannot be offered to consumers any longer, unless its emissions propensity remains below a certain threshold. At any time, polluting emissions of the brown firm are taxed. The brown firm can invest throughout the planning horizon to reduce its emissions. Whether or not it is in the best interest of the brown firm to meet the constraint after or during the second stage will be the result of an optimization problem. We investigate the decisions of the brown firm by studying the Stackelberg equilibrium of a differential game with an endogenous time exit in which the leader is the brown firm and the follower is the green firm. We show that if the brown firm exits in the first stage this must happen at the end of this stage. We also obtain some conditions under which the brown firm exits the market at a finite date (during the first or the second stages) and the conditions under which it never exits the market.

Session 4: July 21st 17:00-17:30

Ranking Quantilized Mean Field Games: Application to Early-Stage Venture Investments

Michèle Breton (HEC Montréal),
Dena Firoozi (Dept. of Decision Sciences at HEC Montréal)
Rinel Foguen Tchuendom (McGill University, GERAD, and CIM, Montréal, Canada)

Mean-field game models involve the distribution of states or controls across the agent population, which in linear-quadratic settings typically reduces to the inclusion of the mean value of the distribution. We address a class of quantilized models, which rather include quantiles of the state distribution. This class of models is a generalization of the classical linear-quadratic setting, where the quantile level is set to 0.5.
Ranking quantilized games model a competition between homogeneous agents, set by a coordinator who aims to select a certain proportion of top ranking agents at the end of the time horizon. The proportion is predetermined and announced by the coordinator before the competition begins, and the performance of the agents is evaluated at the terminal time. The threshold for success is determined based on the collective performance of agents.
We propose an application to early-stage venture investments, where a venture capital firm sets a threshold for success, which depends on the performance of a large pool of startup companies competing for funding over a finite horizon. We provide two formulations for this competition (target-based and threshold-based, where the target-based formulation can be solved analytically. Through numerical experiments, we show that this analytical solution provides a very good approximation for the threshold-based formulation.

Session 5: July 22nd 9:30-10:00

Renewable natural resource management with nonconstant discounting

Jesús Marín-Solano (Departament de Matemàtica econòmica, financera i actuarial and BEAT, Universitat de Barcelona),
Jorge Navas (Departament de Matemàtica econòmica, financera i actuarial and BEAT, Universitat de Barcelona).

In the context of international trade and global resource management, a wide range of agents (as countries, multinational firms, local actors, ...) interact in the management of common-access renewable natural resources, either for direct trade or as inputs in production processes. These agents often differ in their preferences regarding time, influenced by diverse factors such as economic conditions, debt levels, institutional frameworks, regulatory environments, or even cultural values. While most commonly, agents are modeled as employing exponential discounting, which implies time-consistent preferences, in reality, many decision-makers exhibit present-biased behavior, leading to time-inconsistent preferences better represented by nonconstant or hyperbolic discount functions. This paper investigates how the presence of such time-inconsistent preferences affects the management and sustainability of a renewable natural resource. We begin by examining a monopolistic setting in which a single agent exploits the resource over time. Next, we extend the analysis to an oligopolistic environment, where multiple competing agents interact strategically. Here, we explore how competition interacts with discounting behavior, and how different combinations of naïve, sophisticated, and precommitted agents affect both individual strategies and collective outcomes. In our analysis, we focus on the long-run sustainability of the natural resource, as measured by the steady-state resource stocks, and on the overall social welfare. Our results provide insights into the effects of the introduction of time inconsistent preferences in the resource management strategies, the sustainability of the resource, and the individual and social welfare. Keywords: common access resource game; non-constant discounting; precommitment, naive and time consistent strategies.

Session 5: July 22nd 10:00-10:30

Taxes vs. Subsidies with Technology Choice and Endogenous Market Stucture in the Presence of Environmental Aware Consumers

Begoña Casino (Dept. Análisis Económico, University of Valencia),
Luís M. Granero (Dept. Análisis Económico, University of Valencia),
Santiago J. Rubio (Dept. Análisis Económico, University of Valencia).

In this paper, a model with horizontal product differentiation and polluting firms is used for evaluating the effect of a tax on emissions and a subsidy on clean technologies on firm entry, technology adoption, emissions and welfare. In unregulated market equilibrium, private incentives lead to inefficiencies both in the individual profit-maximizing choice of technology and in the aggregate market structure. However, we find that competition promotes the adoption of cleaner technologies with a lower emission-output coefficient, and increases the price if competition is weak. When competition is weak, the firms' markup does not depend on the number of firms in the industry, then an increase in the entry leads firms to adopt a cleaner technology that increases the marginal cost of production and hence the price. The effect of the tax on entry depends on the level of competition. If the competition is strong, the tax promotes the entry and the adoption of cleaner technologies. This effect occurs because for a given level of production, the tax increases the price and reduces the taxes paid by the firm because of the reduction in the emission-output coefficient caused by the tax, these two effects more than compensated the production costs increase. Thus, the tax increases profits

and encourages the entry. Nevertheless, the tax always reduces emissions, but not always increases welfare. When competition is sufficiently low, it is better not to apply an emissions tax. The subsidy always increases the entry, although, not always reduces emissions. When the competition is weak, the subsidy increases emissions. In this case, the entry has a stronger effect on emission than the effect that the reduction in the emission-output coefficient caused by the subsidy has. The subsidy increases welfare when the competition is weak and firms have a strong market power because incentives the production. Nevertheless, it does not increase welfare for any level of competition. In the tax vs. subsidy comparison, we find that the subsidy always gives a higher entry, although not necessary higher emissions.
When the competition is strong, emissions are larger with the tax, but the contrary occurs when the competition is weak. Finally, in welfare terms, the tax dominates for a wider range of values for the entry cost, except when the concentration in the industry is very high. In this case, the subsidy leads to a higher welfare. However, there is a range of values for the entry cost for which regulation, regardless of the policy instrument used to control emissions, reduces welfare.

Special Session: July 22nd 10:30-11:30
Guiomar Martín-Herrán

Session 6: July 22nd 12:00-12:30
Multidimensional Chebyshev interpolation-based methods for differential game problems

Víctor Gatón (IMUVa and Dpto. Matemática Aplicada, Universidad de Valladolid),
Carmelo de Castro (IMUVa, Universidad de Valladolid),
Beatriz Gómez-Martín (Universidad de Valladolid),

In continuous game theory problems, it might be difficult to find analytical solutions, so numerical methods have to be applied. As the number of players grows, this may increase computational costs due to the curse of dimensionality. Value and Policy iteration are two well-known techniques, employed for obtaining numerical approximations to the optimal solution in Control Theory, but they can also be applied in Game Theory differential problems. In a first step, a Value Iteration based multidimensional Chebyshev interpolation method is designed for a differential game theory problem. Chebyshev multidimensional interpolation allows efficient multiple evaluations simultaneously along several dimensions, so this can also be employed to design a tensorial method which performs many computations at the same time. This method can also be adapted to handle parallel computation, which is employed to reduce the computational time cost. The combination of these techniques (tensorization and paralellization) greatly reduces the total computational time cost. As an example, the technique is applied to a several players pollution differential game. Numerical results, including error behaviour and computational time cost, comparing this technique with a spline-parallelized method are included. Employing multidimensional Chebyshev interpolation, a Policy Iteration based method can also be designed. Since Value and Policy Iterations are techniques which have both their pros and cons, the objective of the paper is also to compare the performance, for the same differential game problem, with respect to a Value Iteration based algorithm employing also Chebyshev polynomials.

Session 6: July 22nd 12:30-13:00
Environmental regulation and green reputation: tax evasion versus greenwashing

Francisco Cabo (IMUVa, Universidad de Valladolid, Valladolid),
Guiomar Martín-Herrán (IMUVa, Universidad de Valladolid, Valladolid),
Laís Ramos (Universidad de Valladolid, Valladolid).

The paper analyzes a Stackelberg differential game between a leading regulator and follower polluting firms. Regulation is defined by a tax on emissions plus a fine from misreport. The firms choose the emissions and the reported amount, therefore evasion. The firms maximize profits net of taxes and fines from evasion. Environmentally concerned consumers value the green reputation of the firms, which is measured by a stock variable which decays with the size of firms' evasion. Moreover, low reported emissions can be regarded by naïve consumers as a false signal of firms' greenness, which boots green reputation. This effect can be interpreted as firms' greenwashing. The regulator chooses the tax to maximize social welfare. We analyze how the consumers' credibility on the firms emission disclosure influences equilibrium strategies. With farsighted players, characterized by too large emissions, it induces an increment in the regulator's willingness to tax plus a reduction in the firms' willingness to emit. With myopic players, characterized by too low emissions, it induces the opposite effects. Interestingly, greenwashing improves the environment under farsightedness and worsens it under myopia, although in both cases social welfare improves.