Fellow	Shipra Singh

Host Organisation	Norwegian University of Science and Technology, Trondheim, Norway

Scientific coordinator	Elisabeth Köbis

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

During my ERCIM fellowship, I prepared and submitted two manuscripts in the journals, and one is on-going. The details are given below:

First, we examined how changes in the strategy of players over multiple time scales impact the decision making, resulting payoffs and costs in non-cooperative strategic games. We proposed a dynamic generalized Nash equilibrium problem for non-cooperative strategic games which evolve in multi-dimensions and also defined an equivalent dynamic quasi-variational inequality problem.

The existence of equilibria is established and a spot electricity market problem is reformulated in terms of the proposed dynamic generalized Nash equilibrium problem. Employing the theory of projected dynamical systems, we illustrated our approach by applying it to a 39-bus network case which is based on the New England system. Moreover, we illustrated a comparative study between multiple time scales and a single time scale by a simple numerical experiment.

Second, we examined how can we achieve equilibrium when two related non-cooperative strategic games are being played. We proposed a split generalized Nash equilibrium problem for two non-cooperative strategic games and also defined an equivalent split quasi-variational inequality problem. Further, by using the techniques of proving existence of a quasi-variational inequality problem, we established the existence of equilibria. Moreover, as an application, we motivated introduced split generalized Nash equilibrium problem in the terms of river basin pollution problem.

The third subject of the study is to present the novel approach for some important aspects of the split modeling to cooperative games. We defined a split cooperative game and its core, and interpreted two bargaining schemes for points in the core. We showed that provided bargaining schemes have meaningful heuristic interpretations. Moreover, we also motivated the introduced split cooperative game in the terms of a unified model for the pollution control problem. Further, we intend to present some numerical experiments for illustrating the developed bargaining theories.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

1. Shipra Singh, Aviv Gibali, Split Modeling Approach to Non-Cooperative Strategic Games, Applied Set-Valued Analysis and Optimization, Submitted and under review.
2. Shipra Singh, Aviv Gibali, Simeon Reich, Analysis of multidimensional evolution effects on non-cooperative strategic games, Journal of Optimization Theory and Analysis, Submitted and under review.
3. Shipra Singh, Yair Censor, Elisabeth Köbis, Simeon Reich, Bargaining Schemes for Split Cooperative Games, ongoing.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. Norwegian University of Science and Technology, Trondheim, Norway.
   Norwegian Workshop on Mathematical Optimization, Nonlinear and Variational Analysis. April 26-28, 2023.
   Title of the given talk: Multi-Time Generalized Nash Equilibrium Problem.
2. Fraunhofer Institute for Industrial Mathematics ITWM, Kaiserslautern, Germany.
   Research Internship, December 5-10, 2022.
   Title of Talk: Multidimensional Evolution Effects in Decision-Making Process/Models.
3. Norwegian University of Science and Technology, Trondheim, Norway.
   DNA (Differential Equations and Numerical Analysis) Seminar, May 30, 2022.
   Title of talk: A Multidimensional Approach to Strategic Games of the Game Theory.
4. Technion-Israel Institute of Technology, Haifa, Israel.
   A Workshop on Nonlinear Functional Analysis and its Applications in Memory of Prof. Ronald E. Bruck. April 4-6, 2022.

   Title of talk: Bargaining Schemes for the Split Cooperative Games.

5. Worked with Alesund Brannvesen (fire service) (https://aabv.no) at the European Study Group with Industry (ESGI) 156 workshop (https://www.ntnu.edu/imf/esgi-156) which was held in Ålesund, Norway on June 13-17, 2022.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

Research internship (Research Exchange Program) with Fraunhofer Institute for Industrial Mathematics ITWM from December 5, 2022 to December 10, 2022. I worked with the Department of Optimization in their projects: Optimization in the Life Sciences (https://www.itwm.fraunhofer.de/de/abteilungen/optimierung/life-sciences.html), Production Planning and Control (https://www.itwm.fraunhofer.de/de/abteilungen/optimierung/produktionsplanung-steuerung.html), Energy and Supply (https://www.itwm.fraunhofer.de/de/abteilungen/optimierung/energie-versorgung.html).