# An Airport Gate Reassignment Model with Gate Disruptions

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## Abstract

In this study, we consider a gate reassignment problem that reassigns the set of aircraft to the set of gates. We assume the initial assignment plan—the so-called reference schedule—is known and there are disruptions at some particular gates where they become unavailable either for some specified time interval or from then on. Hence, the initial assignment plan is rendered inefficient and even infeasible. Following the disruption, the aircraft are reassigned to the gates or to the apron—an undesired remote gate. Meanwhile, we are concerned with two measures: efficiency—which is obtaining a "good" plan, and stability—remaining faithful to the original plan.

We apply hierarchical optimization for our efficiency and stability measures. For our efficiency measure, the primary objective is to minimize the number of apron assignments, whereas the secondary objective is to maximize the total number of passengers whose flights are assigned to the fixed gates. By doing so, the airport's fixed gates are well- utilized with a higher priority, while also putting an emphasis on passenger satisfaction. For our stability measure, the primary aim is to minimize the deviation from the reference schedule in terms of the number of aircraft assigned to different gates, since a large-scale schedule change might be ill-favored or indeed problematic, whereas the secondary objective is to maximize the total number of aircraft assigned to the fixed gates among the ones that were originally assigned to apron in the reference schedule. If possible, we want to seize the chance of assigning a fixed gate to a previously ungated flight.

We propose network flow based and assignment based mixed integer linear programming models to both get an initial assignment and a further reassignment under gate disruptions with our efficiency and stability concerns. Using these mixed integer linear programming models, we make various trade-off analyses that would help the airport schedulers to cover their reference schedules with minimum cost and effort.

Our trade-off analyses include the development of solution algorithms favoring the following concerns: optimizing our efficiency measure while keeping the stability level at its minimum level, optimizing our stability measure while keeping the efficiency level at its minimum level and finding the set of non-dominated objective vectors with respect to our efficiency and stability measures.

The results of our extensive experiments based on the layout data of the airports located in Turkey have revealed the satisfactory performances of our algorithms used in the trade-off analyses.

## Keywords
Airport Gate Reassignment Problem, Mixed Integer Linear Programs, Efficiency Measure, Stability Measure, Trade-off Analysis

## Biographies

**Dursen Deniz Poyraz** received her BSc in Industrial Engineering with high honors from Middle East University, Ankara in 2019 and holds a teaching assistant position while pursuing an MSc in industrial engineering from Middle East University. She has completed the corporate finance minor program in Business Administration from Middle East University. She has assisted courses in probability theory, work systems analysis, quality planning and control, revenue management, and financial accounting for engineers. Her research interests include optimization, scheduling, network theory, and multi-objective optimization.

**Meral Azizoğlu** is a Full Professor of Industrial Engineering at the Faculty of Engineering at Middle East University, Ankara. She has received her BSc, MSc, and Ph.D. degrees in Industrial Engineering all from Middle East University. She has worked as a postdoctoral researcher in Management School of University of Wisconsin-Madison and an adjunct assistant professor in the Industrial Engineering Department of Columbia University. She has been a faculty member in Industrial Engineering Department of METU since 1996. Her primary research areas are production and project scheduling, manufacturing systems, and network theory.