

Spatial Optimization to Understand the Essence of Human Society

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Mathematical optimization is a compelling and versatile method that is used in almost all engineering disciplines. In recent years, with the development of Artificial Intelligence technologies such as Deep Learning, it seems that many researchers are focusing their efforts on using more data and developing more sophisticated algorithms. Traditional mathematical optimization, where all objective functions and constraints are manually formulated, seems sober and old-fashioned.

However, to understand the essence of human society, it is more effective to take time to "formulate" their problems. The presenter, whose research field is architectural and urban planning based on operations research, believes both the mixed integer programming (MIP) and the quadratic programming (QP) are the key factors to formulate the essence of human society. By using integer variables, we can directly deal with decision-making. Furthermore, by considering quadratic terms, we can describe the sense of human interactions.

The process of formulation is the iteration of what to keep and what to leave out. This tedious process enables us to make the core of the social system clearer. In the presentation, some human-oriented issues in architectural and urban planning will be solved using the quadratic assignment problem (QAP), which is known as a combination of MIP and QP. Spatial evaluation based on the optimal location of appreciators in a museum blurs even the boundary between the objective function and the constraints. A new clustering method for implied boundaries in regional migrations illustrates the straightforward logic of human connection. These two topics suggest the importance of carefully observing the human values that lie behind them. It is only human beings who can understand our values. The presenter believes that such manual formulation techniques coexist with many other mathematical methods in a future sustainable society.