A Graduate Student Project:

Modeling Human Crowd Dynamics Using Cooperative Game Theory (i.e., Coalitions)

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The ebbs and flows of crowd dynamics mirror the fluidity and rapidity of shifting strategic reasoning by individuals in a crowd. Crowds can be likened to coalitions where individuals perceive to have greater utility acting together than apart. This greater utility in cooperation than acting alone has been modeled in cooperative game theory where group are modeled as coalitions. Two main properties of coalitions that are at the center of coalition formation is increasing nature of collective utility and super additivity.

1. Increasing collective utility: If any set C' that is a strict subset of set C, then $v(C') \leq v(C)$.
2. Super-additivity: For all subsets A and B, the following property holds: $v(A) + v(B) \leq v(A \cup B)$.

The payoff of a coalition C is $p(C) = \sum p_i$.

Payoff, denoted as p_i is the actual amount of earnings by an individual i. The value externally ascribed to C by the society is denoted by $v(C)$.

A coalition C is *blocking* if $p(C) < v(C)$. Although this is a rather nontrivial strategic activity, individual in a crowd continually determine optimal non-blocking sets. We plan to develop a model of dynamic coalition solution for strategies to join a crowd.

References

M. O. Jackson 2008. Social and Economic Networks, Princeton University Press.

Approach:

1. Use GT to formulate the problem.

2. Use MAS testbeds like netlogo to simulate a prototype.