



## An agent based model for networking of scholars



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### ABSTRACT

It is a common phenomenon that at any gathering, people cluster into small and multiple groups to: chat, exchange ideas, establish relations, and explore collaborative opportunities either within their field of work or even in newer frontiers. Certain relationships remain strong and may eventually lead to fruitful collaborations while others may be short lived. Depiction and/or modelling of such an emergent social networking behaviours are inherently complex. With this motivation, in the context of an academic conference, this research focuses on the development of 'Networking of Scholars at an Academic Conference (NASC) Model' using Agent Based Modelling and Simulation (ABMS) technique. The paper describes the model and its implementation in NetLogo. NetLogo is powerful programming environment that facilitates the generation of scenarios and thus helps visualisation of emergent network of relationships among scholars.

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#### 摘要

常见的现象是任何聚集在一起的人群,这些人组成几个小群体,在他们的专业领域,有时甚至在某些前沿学科,物谈、交换意见、建立关系、以及探讨合作机会。某些关系保持密切并可能最终导致成果丰富的合作关系,而某些关系则是短命的。对这些初步的社交网络行为的论述和/或模型制作天生就是复杂的。带着这个动机,在学术会议上,本研究关注的是“学者在学术会议上的社交网络”模型的发展,采用的是基于主体建模和模拟技术。本文论述该模型及其在NetLogo内的实施。NetLogo是一种强有力的编程环境,促进场景的生成,有助于学者中新出现的关系网的视觉效果。

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## 1. Introduction

Academic conferences assure lively forum for scholars for presenting their professional work as papers and posters, intellectual exchanges and debates of their researches, gain knowledge by attending workshops and field trips. In addition to that conferences provide opportunities to join with other scholars to develop cultural, social and scholarly market places for professional developments and collaborative work (Friedkin, 1984; Liberman and Wolf, 1997). In the broader sense, conferences encourage networking among participants could they be new connections, meeting old contacts and/or avenues build long-term relationships. Since a conference is a middle ground, acts as an intermediary among academic faculty, research students, industry practitioners,

researchers, industry/product promotional marketers and sales people. Due to the fact of the respective professional boundaries and opportunities present, the knowledge, interests and experience level of the participants may vary, for example from a professor to sales person. Therefore, when these differing groups of people come in contact with each other during the conference, their interactions will not only be driven by their personal behaviours but also their professional attitudes and interests. Thus a study of networking behaviour of scholars is interesting, but challenging due to the complicated and dynamic nature of participants.

## 2. Research context

The online dictionaries define an academic conference as a conference for researchers (not necessarily academics) to present and discuss their work. Together with academic or scientific journals, conferences provide an important channel for exchange of information between researchers. The mutual relationships that form among the conference participants at can actually facilitate a

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network of connections among them. Several authors have studied on how such networks evolve and the behaviours of these networks. Mergel et al. (2005) employed the homophily arguments (tendency for people to connect with others who have similar attributes and behaviour) as well as theories of status and career/life cycle to determine the factors led to the establishment of ties from interactions at the International Network for Social Network Analysis. Berardo (2010) concluded that advice networks are approximately three times as dense as the networks of written collaboration. Wang and Li (2010) suggested that complete and systematic approach is necessary to realize and analyse academic network and used social network analysis (SNA) methodology. McCarthy et al. (2004) indentified the opportunities for interaction are unevenly distributed among attendees at academic conferences and extend the opportunities by designing AutoSpeakerID (augmented formal conference paper sessions) and Ticket2Talk (augmented informal coffee breaks).

Despite the progress in analysing and studying the academic networking, little advance is made to model the phenomenon due to the complex nature of the interactions among scholars. Recent advances in Agent Based Modelling and Simulation (ABMS) techniques with roots in complex adaptive systems are emerging to help the researcher to model interactions among intelligent beings. With this motivation, this paper focuses on modelling networking of scholars in an academic conference setting using this relatively new technique, ABM that has a powerful mechanism to visualise the emergence of patterns.

### 2.1. Research questions and hypotheses

The principal motivation for this research is to find an answer for the question: “What encourages the development of strong links between conference participants?”

The research question implies two hypotheses, as follows:

**Hypothesis 1.** Fewer number of participants results in the development of stronger links between the participants.

**Hypothesis 2.** The number of interaction opportunities has a positive causal effect on the number of strong links developed between participants.

We aim to address these hypotheses by building a simulation model. NetLogo provides an easy environment where participants are represented as agents, and their interactions over time can be analysed through a set of assumptions. The assumptions are portrayed as explicitly as possible to that output of simulation runs can be visualised. NetLogo facilitates to experiment with varying values to assumption variables through the NetLogo interface. The next section briefly describes the model construction, followed by discussion of results obtained through analysis. We also share the network of relations through a small sample obtained during our ABM training program. The last section also looks at the limitations of the study and what opportunities exist for future research.

## 3. Model construction

In formal or informal gatherings it is noticeable that some people may attract the other participants more than their peers. These popular participants may be the centre of attraction either due to their eloquence, lively debate on some hot topics and in case of academic gatherings these could be prominent researchers who had worked or working on interesting or emerging areas of knowledge. While several attributes together might explain this prominence, it is worthwhile to a build a model with simple concepts

and progressively increase the complexity as the model's formative or predictive nature gets validated. We assume that ‘Sociability Index (SI)’ and the willingness to mix with other professionals (P) are the key factors in the formation of relationships; as such the NSAC Model builds on these assumptions. They are expressed as a fractional value ranging from 0 to 1, 0 meaning very low sociability or lack of willingness to mix and 1 meaning high sociability or extremely open to mix.

As noted earlier, the general professions of participants at an academic conference are academic staff, research student, or people working in research and development establishments. It is natural that in an informal gathering people tend to initiate dialogue with similarly positioned peers more easily and form networking links with them as some mutually interesting and beneficial common factor emerges out of their dialogue. The other interesting aspect at these gatherings is that people who know before or people from the same institute likely to cluster initially and sustain than a cluster fully heterogeneous participants belonging to several different institutes.

### 3.1. NetLogo representation

In NetLogo participants are referred to as agents. Agents have built-in attributes like shape, size, colour etc. The modeller can assign additional attributes, like SI as noted above. NSAC model utilises colour to designate university, shape to convey profession and size to express SI of each participant. Fig. 1 provides the NetLogo interface of the model. User defined settings allow the user to choose a value for each of the exogenous variables. Setup and Go buttons allow the initialisation of the simulation environment and running of the simulation, respectively. The right hand side of Fig. 1 depicts a conference environment with agents distributed randomly across a meeting room. The five rectangular boxes to the left are the gathering locations for the agents during session breaks.

The NetLogo programming environment provides several outputs. On the left side of Fig. 1 output monitors consisting of graphs and various endogenous variables. There are also a group of switches called “user defined settings,” namely:

ProbConnectOtherTypes	Probability for a participant of on profession type to connect with other profession
Numberof Participants	Number of participants for the conference
SociabilityIndex	Sociability level a participants to form links with others
BreaksPerday	Number session breaks like morning tea, lunch, evening tea
ConferenceDays	Conference duration in days
PercentWithPriorConnections	Percentage of participants who have prior connections

The NetLogo allows the user to simply slide the switches and assign values to the variables. Then the user can run a simulation changing either each or all of the switches at each instant. This provides a flexible mechanism to generate various scenarios, for example, a conference of 3 days, 4 days or 5 days etc. At the end of the simulation run the user can visualise the links formed by clicking on the show circle of links buttons. The Buttons labelled ‘Show circle of links UNI’ and ‘Show circle of links PROF’ allows the user to see the link formations after each completed simulation run. The link formations can be viewed in two different modes, categorised either by university or profession of the participants.

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