Parameterising the Dynamics of Inter-Group Conflict from Real World Data

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I. Introduction

A major concern in asymmetric warfare is the threat coalition operations face from insurgent group activity [1], [2]. In many cases, such groups are loosely and chaotically organised, but their ideals are sociologically and psychologically embedded across members such that the group has expected behaviours that can represent a threat. Therefore understanding how groups change, interact and conflict in different situations is of significant interest. However it is frequently the case that limited pre-existing data is available from which techniques such as machine learning can be employed to make predictions of the future based on past events. As such, alternative approaches to gain insights into possible future behaviour are needed.

In this context *generative modelling* is a promising approach which has gained considerable interest for studying social phenomena. Developing models of this nature is complex as it involves emulating human behaviour. To make progress, models need to be grounded in relevant psychological and sociological theory that can be translated to a quantitative representation. Furthermore, for modelling to support decision making, there needs to be accurate representation of a physical scenario, and confidence in the model's ability to generate "real world" behaviours needs to be examined. In this paper we consider both of these issues by examining the use of existing datasets towards parameterising and testing generative models.

II. Framework for examining conflict data

Due to the diversity of data available on conflicts, a common framework for organising data extraction is needed. The framework we propose is motivated by the widely used approach of classifying behaviour by asking *who, what, when, where* and *how?* It is therefore necessary to translate this to a form that can be used for inter-group situations, potentially where there are many events and multiple groups. Our proposal for achieving this identifies three fundamental components that need to be considered. These concern: (i) inter-group structure, (ii) inter-group actions and (iii) impact of actions.

Inter-group structure concerns the number of identifiable groups as entities that form the basis of modelling. Inter-group actions represent individuals acting on behalf of groups, towards another group (or groups). The impact of actions concerns interpreting the outcomes of actions that are targeted at groups. Event-driven generative models of conflict require these components to be parameterised in some way (visualised Figure 1), in which we propose using real world sources as a basis and demonstrate this with example data.

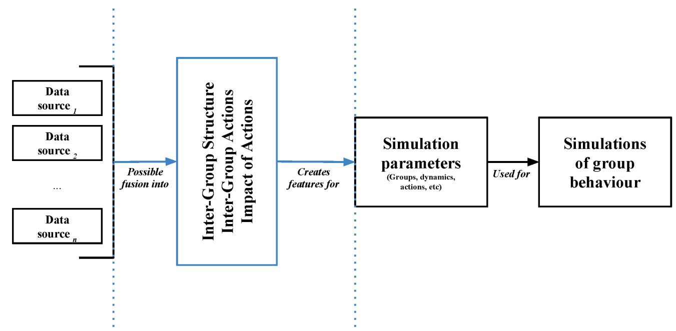

Fig. 1. Schematic representation of parameterising generative models (outlined in blue) from real world data.

III. Examining datasets of conflict

Several popular and substantive datasets exist in the literature, including: SCAD [3], UCDP [4], ACLED [5], and the UCINET covert networks (UCN) datasets from the UCINET software package [6]. These datasets capture different information surrounding the characteristics of groups in conflict, the events that take place between them, or both. Collectively, these datasets have been involved in extensive research into trends of conflict across the world, but to the best of our knowledge, they have not been used as a basis for creating generative models of group conflict.

We examine the SCAD Africa v3.2 dataset [3] as an example case study. The results of this case study demonstrate how it could be used to help parameterise generative models. Importantly, the case study highlights that the event-based format of this data set results in the need to post-process the dataset to extract features that are relevant to generative models.

Inter-Group Structure, actions and impact

The dataset primarily focuses on the characteristics of individual conflicts, providing limited detail concerning the parties involved. As a result, details surrounding the structure of individual groups (i.e., size, leadership, connectedness) and their members are not provided. However, where the groups

TABLE I
CHARACTERISTICS OF UNIQUE GROUPS EXTRACTED (N=9110).

Characteristic	# Groups
Type of group	
State	1530
Non-state (or unknown)	7580
Passiveness: Proportion of actions performed/received	
Always recipient of conflict	3873
Always instigator of conflict	4414
Both instigator and recipient	823
Cooperativeness: How often groups act together	
Always cooperative	1091
Never cooperative	7276
Sometimes cooperative	743

involved are distinguishable (e.g., "Al-Qaeda", rather than "Youths", or whether the group is the state), this information can potentially be supplemented by using additional datasets. Other characteristics can be extracted through examining patterns in group actions. Some examples of these (shown in Table I) include the passiveness of a group (through whether a group is always the recipient of conflict, the source, or both), and the cooperative nature of a group (through whether they always, sometimes, or never cooperate with another party when conducting an action). As well as the characteristics of groups, inter-group relationships can also be seen. Figure 2 shows an example graph created for a subset of the dataset to illustrate inter-group cooperation and conflict, showing varying degrees of connectivity and network motifs.

Another challenge in creating event-driven generative models concerns determining the types of actions that can occur, including how often, at what cost to the instigator, and the impact on the receiver. While the SCAD dataset does not offer insight into the decision process behind actions or the cost of actions, it does enable analysis into a) the typical characteristics of actions, and b) temporal-spatial patterns which provide insight into the extent to which different actions are conducted by groups. This can be used to estimate the typical probabilities of actions being performed for groups with given characteristics. This can also include fitting to appropriate statistical distributions (shown in [7]), which may feature as an important component in particular types of generative models (e.g., [2]).

Finally, the impact and fallout of an action are challenging to observe as this may be obfuscated when viewed from an external perspective. This is reflected in the limited detail contained in the SCAD dataset, nevertheless, high level insights can be made from this information, such as whether actions result in escalation.

IV. CONCLUSIONS AND FUTURE WORK

A challenge in building and experimenting with generative models of inter-group conflict is the choice of parameters and their values, with a spectrum of values often used to examine how this impacts upon a model. Despite this, the validity in terms of being representative of real world behaviour can often not be definitively concluded. This has formed the primary focus of this paper through examining how real world datasets can help inform the design of parameters and their values. This presents several potential areas of future work, in particular, how multiple data sources can be fused together (e.g., to provide additional geographical semantic detail surrounding events).

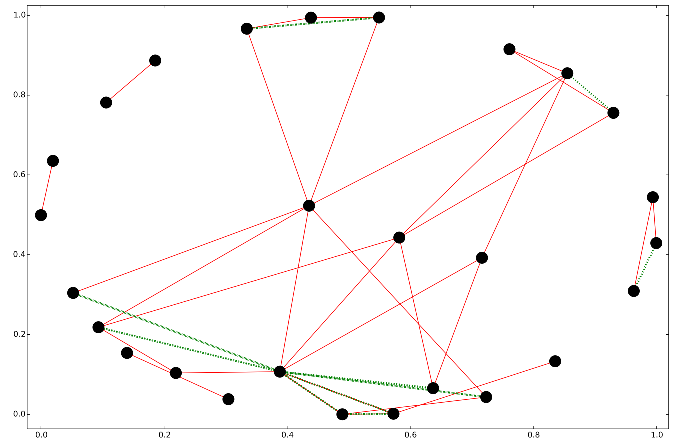

Fig. 2. Example network created from the SCAD dataset, from "Spontaneous Demonstration" conflicts in Egypt in 2014. Nodes represent actor (groups). Red links indicate at least one event performed from one node to another. Green dotted links indicate cooperation for at least one event between nodes.

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