Multimode and Multilevel: Vertical Dimension in Historical and Literary Networks

Martin Grandjean
martin.grandjean@unil.ch
University of Lausanne, Switzerland

Introduction

In the field of global history, especially when it comes to « histoire croisée », the use of metaphors describing the vertical organization of a society, its structuration into layers or into overlapping systems, is common. The temptation to use a second metaphor, calling everything a "network", is also very important in this domain, whose objects of study are often transnational organizations with multiple branches, intertwined within umbrella organizations, sharing board members and including several levels of secretariats and subcommittees (Grandjean 2017). However, the use of these images is not limited to historical studies, since we use the same vocabulary in other disciplines to describe social situations or textual structures.

When we go beyond the metaphor to develop a formal analysis, we often produce multigraphs who, because they simultaneously express horizontal and vertical relationships, are generally unsuitable for the analysis (and visualisation, except in very simple cases). If the "exploratory" dimension of social network analysis – and especially the fact that its display is relatively subjective – is often a subject of criticism, we propose here to play with the visual representation to show precisely how an original modelling can improve the reading of complex graphs, and helping to restore a "morphological" (Moretti 1999, 68) information where disorder seems to prevail.

Based on two examples from archives mapping and theatre character networks, this paper proposes a reflection on the different ways to take account of verticality in graphs. In particular, we are developing a way to impose a macro-structure to a network, allowing a two-dimensions view that reflects the hierarchical affiliations of its components. We will see that this method, by constructing a stable visual representation in time and space, helps to compare different types of relationships and/or different time states of the graph.

Network levels

What is evident in an affiliation network is not always explicit in other situations, but a multimode graph is always the expression of a form of multilevel network (Lazega and Snijders 2016). For instance, there is an implicit hierarchy among the committees level and the level of individuals within them. It is thus easy to imagine such networks as superimposed layers, linked by the vertical affiliation links. And this analysis is obviously interesting because these vertical links are not the only ones to influence the model structure: committees in the upper stratum may themselves be organized into their own horizontal structure, as well as individuals, in the lower stratum, can weave relationship regardless of the structure of the committees to which they belong. This kind of macro/micro-structure comparison is not new in sociology: through sociometric approaches of urban social structures, for example, some address the organization of metropolitan communities together with that of interpersonal relationships (Laumann 1973). This raises the issue of representing these networks within a two-dimensional plane, e.g. by changes in the colour and shape of the markers (Wang et al. 2016), or by an artificial transfer of the upper-level in a region of the graph that enables them to be read (Zappa and Lomi 2015). When the low complexity of networks allows, some may also use three-dimensional representations, clearly indicating the superimposed planes (Brailly and Lazega 2012).

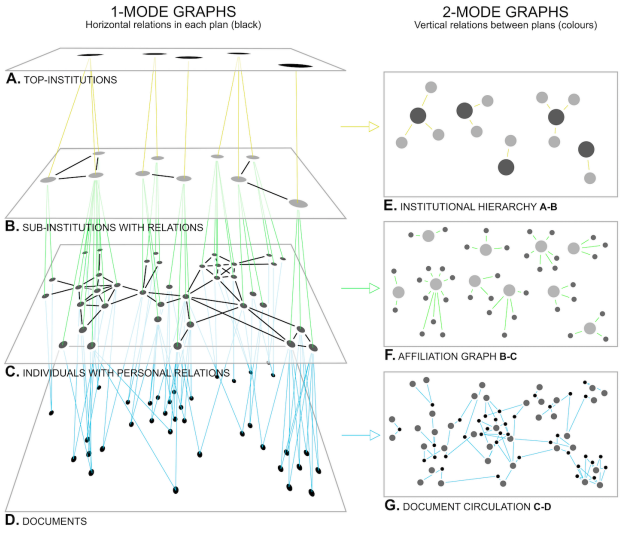

Figure 1. Multilevel system of networks where individuals having personal relationships (C) and exchanging documents (D) are affiliated to institutions (B) themselves hierarchically organized (A). E, F and G visualize in 2D the vertical relationships expressed in 3D left.

The model: projecting structure on relations

Fig. 1 visually explains a relatively simple multilevel graph, with four levels of actors (documents D, exchanged by individuals C belonging to sub-institutions B themselves grouped by top-institutions A) and five different types of relationships, including three vertical. This example depicts an institution, but it can be exported in a wide variety of domains : it may well be a medieval family network (C) in villages (B) under the authority of lordships (A), and sharing agricultural properties (D). Or theatre characters having friendship relations (C), organized in groups (B) and appearing together in scenes (D). In these examples, we see very concretely how the 2-mode graph express vertical relationships.

Secondly, we proceed to a flattening of the hierarchical structure of the two upper levels as sets containing the elements to be studied (here, individuals), as in Fig. 2 (I). Now it is no longer the horizontal relationships between individuals (C) that affect the display of the graph but these sets, fixed once and for all.

Creating a stable spatialization is the condition for a comparative analysis: we can therefore display side by side the graph of document exchanges (J, product by projecting G as a 1-mode graph of individuals) and the graph of interpersonal relations (I), without a reorganization of nodes that would make the hierarchy unreadable.

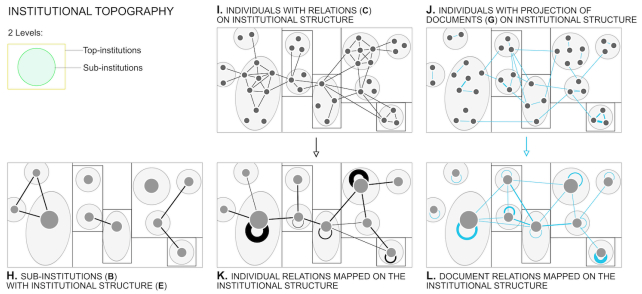

Figure 2. To reduce the complexity of a multigraph and allow a comparative analysis of different types of relationships, we gather the micro-level relations (I and J) in the macro-level structure. Here, we therefore compare inter-institutional relations (H), the personal relations of the individuals (K) and the documents exchanged between them (L), all summarized in sub-institutional level.

Then we move to the upper level by summarizing the individual relationships as relations between the groups they belong to. We can now compare the institutional relation between these groups (H) with personal relationships (K) and the exchange of documents (L). In our example, we see that the patterns are very different, even though a majority of relationships logically occur within the sub-institutions (see self-edges in K and L).

Applications

When Sampson, in the central square of Verona, calls his colleague Gregory, also a servant in the Capulet family, he creates the first edge of the character network of Shakespeare's tragedy « Romeo and Juliet » (for more discussion of the study of character networks, see Trilke et al. 2015 and Xanthos et al. 2016). The readability of the interaction graph of this introductory scene, the confrontation of the two hostile houses, is greatly enhanced by a highlight of these vertical relationships (Fig. 3), the affiliations of all the protagonists to family identities that will structure the plot.

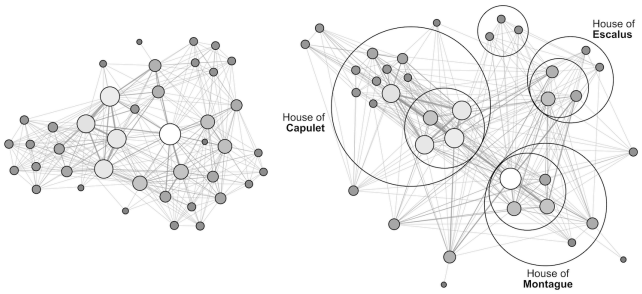

Figure 3. The character network of Shakespeare's tragedy "Romeo and Juliet" (Grandjean 2015). Two characters are connected if they appear simultaneously in a scene. On the left, the network is spatialized with a classical force-directed algorithm, and on the right by imposing a "family geography") (family in the inner circle, servants in the outer circle).

In the context of more complex networks, where it is less about creating a new visual and pedagogical artifact to facilitate narratological studies than to find a way to automate pattern detection, we will also discuss the case of network analysis of large archive corpora (Grandjean 2014). In this case (Fig. 4), we will show in particular that it is possible to detect individuals that bypass institutional hierarchy, when horizontal relationships do not align with vertical affiliations.

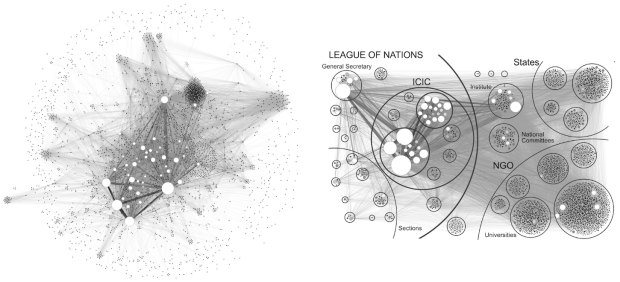

Figure 4. Cooccurrences network of more than 3,000 scientists and diplomats in the 30,000 documents of the "International Commission on Intellectual Cooperation" of the League of Nations (archives 1919-1927). On the left, the network spatialized with a force-directed algorithm, and on the right spatialized by imposing a vertical hierarchy, flattening the affiliation of each individual in a kind of "institutional geography (Grandjean 2016).

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