

Quantifying convergence in the sciences

S. Lumbreras Sancho; P. Mealy; C. Verzijl; S. Way

Abstract-

Traditional epistemological models classify knowledge into separate disciplines with different objects of study and specific techniques, with some frameworks even proposing hierarchies (such as Comte's). According to thinkers such as John Holland or Teilhard de Chardin, the advancement of science involves the convergence of disciplines. This proposed convergence can be studied in a number of ways, such as how works impact research outside a specific area (citation networks) or how authors collaborate with other researchers in different fields (collaboration networks). While these studies are delivering significant new insights, they cannot easily show the convergence of different topics within a body of knowledge. This paper attempts to address this question in a quantitative manner, searching for evidence that supports the idea of convergence in the content of the sciences themselves (that is, whether the sciences are dealing with increasingly the same topics). We use Latent Dirichlet Analysis (LDA), a technique that is able to analyze texts and estimate the relative contributions of the topics that were used to generate them. We apply this tool to the corpus of the Santa Fe Institute (SFI) working papers, which spans research on Complexity Science from 1989 to 2015. We then analyze the relatedness of the different research areas, the rise and demise of these sub-disciplines over time and, more broadly, the convergence of the research body as a whole. Combining the topic structure obtained from the collected publication history of the SFI community with techniques to infer hierarchy and clustering, we reconstruct a picture of a dynamic community which experiences trends, periodically recurring topics, and shifts in the closeness of scholarship over time. We find that there is support for convergence, and that the application of quantitative methods such as LDA to the study of knowledge can provide valuable insights that can help researchers navigate the increasingly wide literature as well as identifying potentially fruitful areas for research collaboration.

Index Terms- convergence, topic modelling, latent dirichlet allocation, complex adaptive systems

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