Citation networks provide invaluable information for tracing historical developments in science. The idea of tracing scientific developments based on citation data goes back to Eugene Garfield, the founder of the Science Citation Index. In a report published more than 50 years ago, Garfield and his co-workers concluded that citation analysis is “a valid and valuable means of creating accurate historical descriptions of scientific fields” \cite{Garfield1964}. Garfield also developed a software tool called HistCite that visualizes citation networks of scientific publications. This tool supports users in tracing historical developments in science, a process sometimes referred to as \emph{algorithmic historiography} by Garfield \cite{Garfield2003a,Garfield2003b,Garfield2004}. More recently, a software tool called CitNetExplorer \cite{VanEck2014} was developed that has similar functionality but offers more flexibility in analyzing large-scale citation networks. Other software tools, most notably CiteSpace \cite{Chen2006} and CRExplorer \cite{Marx2014,Thor2016}, provide alternative approaches for tracing scientific developments based on citation data.

Main path analysis, originally proposed by Hummon and Doreian \cite{Hummon1989}, is a widely used technique for tracing historical developments in science. Given a citation network, main path analysis identifies one or more paths in the network that are considered to represent the most important scientific developments. Many variants and extensions of main path analysis have been proposed \cite{Batagelj2003,LucioArias2008,Liu2012,Yeo2014,Liu2016,Tu2016}, not only for citation networks of scientific publications but also for patent citation networks \cite{Verspagen2007,Park2017,Gwak2018,Kim2018,Kuan2018}.

In this paper, we introduce a new approach for tracing historical developments in science based on citation networks. We propose the idea of intermediacy. Given two publications dealing with a specific research topic, an older publication and a more recent one, intermediacy can be used to identify publications that appear to play a major role in the historical development from the older to the more recent publication. These are publications that, based on citation links, are important in connecting the older and the more recent publication.

Like main path analysis, intermediacy can be used to identify one or more citation paths between two publications. However, as we will make clear, there are fundamental differences between intermediacy and main path analysis. Most significantly, we will show that main path analysis tends to favor longer citation paths over shorter ones, whereas intermediacy has the opposite tendency. For the purpose of tracing historical developments in science, we argue that intermediacy yields better results than main path analysis.

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Kim2018: <https://doi.org/10.1007/s11192-018-2834-3>

Kuan2018: <https://doi.org/10.1016/j.joi.2018.01.005>

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LucioArias2008: <https://doi.org/10.1002/asi.20903>

Marx2014: <https://doi.org/10.1002/asi.23089>

Park2017: <https://doi.org/10.1371/journal.pone.0170895>

Thor2016: <https://doi.org/10.1016/j.joi.2016.02.005>

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Verspagen2007: <https://doi.org/10.1142/S0219525907000945>

Yeo2014: <https://doi.org/10.1007/s11192-013-1140-3>