Online Information Ripples – A Conceptual Model for Analyzing Information Dissemination Patterns in Social media

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Abstract: Today we are sharing and recommending content and information with our online social networks and with that, generating social traffic that does not use search engines to find content. Potentially information dissemination in social media can be very efficient and the information can reach a great number of people in a very short period of time. However, little is known about the information dissemination patterns in social media and how our online information behavior may have changed. In this article we propose the conceptual model of online information ripples as a metaphor for information dissemination in social media and present how the metaphor could benefit research about online information dissemination and information behavior. The benefit of studying information dissemination as ripples and waves in social media is that it opens new possibilities to new discoveries using methods previously not used in information science.

Keywords: information dissemination, ripples, waves, sharing, social media

Introduction

When we search the web for definitions of social media some words are frequently repeated. Most of the definitions agree that social media is about user-created content, interaction between people, social sharing of content, and that it is all happening on the web. In other words, social media is about web services where people can interact with each other, share content and co-create content to the web. The web has become important in our everyday lives but the way we are using the web is changing because of social media. The web used to be a place where we searched for information, but today it is a place to share information and to interact with other people. The web is still a huge information source, but today the emphasis has shifted from information seeking to information sharing. This shift may well be the biggest change online since the advent of commercial search engines. Perhaps we can even say that we are moving away from an *information society* and towards a *recommendation society?*

So called social traffic generated by online information sharing counts for a rapidly increasing amount of traffic on the web and it may be traffic that is away from search engines and other information sources. A randomly picked article about iPad 2 on the popular technology blog Mashable in March 11, 2011, had been tweeted 1,481 times and shared on Facebook 156 times in a single day (White, 2011). This means that within about 24 hours after the article was published 1,481 people had shared the article with their followers on Twitter and that 156 people had shared the article with their social networks on Facebook. Both the average number of followers on Twitter (Arthur, 2009) and the average number of friends on Facebook (2011) are around 130. This means that potentially over 212,000 people have received information about this article on Mashable or they have received a recommendation to read the article. All of these people could share the article forward with their social networks and help information disseminate even further to approximately over 27 million people in the second degree. However, everybody will probably not share the information forward for some reason and there may also be some overlap in the social networks decreasing the potential number of people that could receive the information. But still online information can potentially reach a great number of people very fast.

Almost everything online today can be shared with social networks on Facebook, Twitter, StumbleUpon and in many other places. Opportunities for information sharing can be created by adding widgets like AddThis[1] and ShareThis[2] on websites, blogs, photo galleries, and other online content. Visitors to the website can then share the content to their online social networks simply by clicking on a button. TechCrunch reports on data they received from Gigya[3], a service that offers sharing widgets for websites, that within a 30 day period almost a million items had been shared through Gigya's widgets and Facebook had been the destination in 44% of the cases (Schonfeld, 2010). About 29% of the items were shared on Twitter, 18% through Yahoo and 9% on MySpace. StatCounter (2010) reports that Facebook would be responsible for nearly half of all traffic that comes from social sites, while StumbleUpon and Twitter and other social media sites are far behind. Facebook (2011) alone claims that over 30 billion items are being shared on Facebook every month.

[1] Add This, http://www.addthis.com/
[2] Share This, http://sharethis.com/
[3] Gigya, http://www.gigya.com/

Online content that is being shared and received by online social networks are in a way recommendations to view some online content. It is not necessary anymore to use search engines to find interesting content, because friends and acquaintances in our online social networks share and recommend content they have found with us. When we get a recommendation from a friend, we tend to trust that recommendation more and it is more likely that we will act upon it than if we see an ad in newspapers or on television or find a hyperlink on some website. Social traffic may have a major impact on our online information seeking behavior and even on our shopping behavior on the web. Recommendations spreading in social media are potentially very powerful tools for marketing and for information dissemination in general, however, the impact of these recommendations may be challenging to monitor and the dissemination patterns may be difficult to map. Webometric methods can be used to collect hyperlinks and occurrences of specific keywords, such as hashtags on Twitter, and to analyze connections and relationships between people (e.g. Thelwall, 2009; Holmberg, 2009). Social network analysis can be used to map and visualize the structure of the networks and to e.g. discover the most influential people in an information dissemination network (e.g. Hanneman and Riddle, 2005; Wasserman and Faust, 2007). So far the frequencies of occurrences and the sources of traffic have been the major source of information that have been measured and analyzed. But information dissemination in social media can be seen as waves of information travelling through online social networks, as ripples of information spreading from a clear starting point to wider and wider audiences. Information ripples can provide information about e.g. speed, magnitude, direction, influence and efficiency in a more diverse way than just simple frequencies can. This conceptual paper discusses how online information dissemination patterns can be mapped using the metaphor of information ripples and how this approach can help when studying changes in users' online information behavior.

Information dissemination in social media

To describe information dissemination in social media some have used epidemiological techniques (McCormack & Salter, 2010) while others have taken a more sociological approach (Zhao, Wu & Xu, 2010). Information dissemination has in some cases been described even as explosive (Kwon, Kim & Park, 2009) and in a best case scenario information can spread very wide and for a long period of time. How information spreads in social media depends first of all on the network structure but also the topic of the information and content play a significant role. Different types of content spread differently. Breaking news usually get retweeted forward frequently on Twitter (Boyd et al., 2010) while the majority of tweets are not retweeted at all. Cha, Pérez and Haddadi (2009) discovered that political news videos spread fast but not for a very long time in blogs, while music videos spread over a longer period of time but not as fast. It has also been discovered that online information spreads in a narrow and deep tree-like social structure (Liben-Nowell and Kleinberg, 2008). This suggests that we carefully choose what we share forward and that there is perhaps something in the sender that influences our decision to forward information that we receive. Everything received do not get shared forward. We may only forward information that we receive from our closest contacts or people that we regard as knowledgeable in some areas or people that we have most in common with, and hence the pattern of information dissemination in social media is in some cases narrower rather than wider.

So called weak ties (Granovetter, 1973; 1983) play an influential role for information dissemination even in online social networks (Zhao, Wu & Xu, 2010). Weak ties in social networks are the ties between persons that are acquainted but not close friends. Close friends usually have very similar social networks and they share many friends, hence they have access to roughly the same information sources and they also receive roughly the same information. People that we do not know that well and that we have a weak tie to, have different social networks that are not overlapping so much with our own social networks. Through these weak ties we can have access to new information sources and knowledge that we do not have access to through the strong ties in our own tightly connected network. It is only through the weak ties that information and content can reach larger audiences as the weak ties function as bridges between tightly connected clusters of people. Liben-Nowell and Kleinberg (2008) showed that in some cases in social media information spreads in a narrow and deep tree-like pattern. This may be due to the fact that perhaps we forward content that we have received from our closest friends and contacts. The weak ties are not disseminating information because they are not receiving it or because they simply ignore it. This may however be tightly connected with the type of a particular social networking site. While the connections on Facebook may mostly be between friends and acquaintances, followers on Twitter are not necessarily even acquaintances. It is possible that the information dissemination pattern on Facebook is very different from that of Twitter or some other social networking site. Information dissemination on Twitter can be wider and perhaps shallower than on Facebook due to the weak ties, while the situation on Facebook would be reversed with a narrow and deep pattern of information dissemination, like the structure discovered by Liben-Nowell and Kleinberg (2008). In a wide pattern of information dissemination information is spreading in all directions away from the starting point, the point where information was first published, like ripples on water.

Microblogging site Twitter has become a popular tool for information dissemination and communication. Twitter has lately played a significant role in disseminating information about e.g. the uprisings in Tunisia (Ash, 2011), Egypt (Schonfeld, 2011) and Libya (Mackey, 2011), and the earthquake in Japan (Preston, 2011). Twitter's API (https://dev.twitter.com/) allows developers and researchers to access and research the stream of tweets, which makes Twitter an interesting source of information when studying information dissemination patterns. Messaging on Twitter, or tweeting, has been researched as electronic word of mouth (Jansen et al., 2009) where positive and negative commenting of the studied brands spread through Twitter networks. Jansen et al. (2009) state that people's purchasing decisions are increasingly effected by the information they receive from their online communications, which makes micro-blogging sites such as Twitter important tools for brand management, marketing and perhaps even for competitive intelligence. Scanfeld et al. (2010) studied tweets that could potentially indicate misuse or misunderstanding of the use of antibiotics. The study showed that information about misuse or misunderstanding of the use of antibiotics could in fact be collected from twitter, which suggests that Twitter could potentially be used as tools to collect and to map dissemination of real-time health information. People retweet for a variety of different reasons (Boyd et al., 2010). Earlier research (Boyd et al., 2010) have shown that people retweet because they want to spread information to new audiences or a specific audience of followers, they may retweet because they want to comment on someone's tweet or make the original writer aware that they are reading their tweets. People also retweet to publicly agree with or to validate someone's thoughts, to be friendly, to refer to less popular content in order to give it some visibility, but also for egoistic reasons like e.g. to gain more followers or gain reciprocity. Tweets are also retweeted so that they are saved for later access.

The practice to retweet and the API that makes data collection from Twitter fairly easy are things that make Twitter a promising and interesting place to study online information dissemination on. When breaking news or some other interesting tweet is published, it immediately starts to spread to wider and wider audiences as people are sharing the message by retweeting it. The information is spreading like ripples away from the starting point.

Information ripples in social media

Metaphors are powerful tools in science as they help us understand and conceptualize different phenomenon and allow for new discoveries to be made using novel approaches. Online information ripples is a strong metaphor for the information dissemination or diffusion patterns in social media as online information ripples can be seen as waves of information travelling through series of websites, blogs, and social media in networks of hyperlinks, references and people. By studying online information dissemination as ripples or waves we can import methods from physics to analyze the phenomenon and to potentially gain more knowledge about the patterns in which information spreads in social media. In figure 1 below we present our conceptual model for online information ripples.

In Figure 1 below, A is the first entry point of content or information in social media. A could be the first news about an earthquake, a new music video on YouTube or the start of an online marketing campaign. A metaphor for A would be a stone cast in to a calm lake, creating ripples that move away from the entry point at various speed and length. The first ripple includes occurrences B, C and D in Figure 1 below. These are the secondary sources that cite, retweet, share or link to the entry point A creating a new wave front and a new ripple. These are the first steps where information is spreading wider in social media. The second ripple (E, F and G in Figure 1) can reference to the entries in the first ripple or they can reference directly to the entry point A. Information about the movement of the ripples can be gathered by using webometric methods to collect the links that target the original source or by collecting all tweets that contain a certain hashtag or some other unique text string. Information continues to spread in new ripples in social media as long as people are sharing it, retweeting it or linking to it.

The thicker arrows in Figure 1 show the direction where information is being disseminated. These arrows also indicate the direction of time; the first ripple around the entry point A is created immediately after A has entered social media. Before the second circle has been formed some time have already passed since A happened. Time is of special interest as faster dissemination of information means that the message gets passed on more efficiently and how efficiently information spreads in social media is of particular interest when measuring the success of e.g. marketing campaigns. The direction of the information wave could be determined by using the information about the location of the people creating the wave. This information could then be mapped on a geographical map for closer analysis.

With methods borrowed from physics it is possible to analyze e.g. the amplitude and the length of online information ripples. Amplitude equals to the frequency of entries within a certain time period and it tells something about the strength or impact of the information or content disseminated. In practice amplitude could be calculated as the number of retweets or tweets mentioning a certain hashtag or a keyword within a certain time (e.g. an hour). Length of the wave is the time it took for the wave to reach a certain (predetermined) amount of entries that are sharing the content forward. For popular topics the amplitude would be high because of the many entries it would get and the wave length would be short as a certain amount of entries would be reached quickly. Both amplitude and wave length use the same data, time and number of tweets (or links, likes, mentions, etc), but they reveal different characteristics of how information is spreading online. Measures like these could be useful when comparing the impact of different messages travelling through social media. Even other concepts from physics can be advantageous to combine with webometrics and social network analysis to use in research about online information ripples.

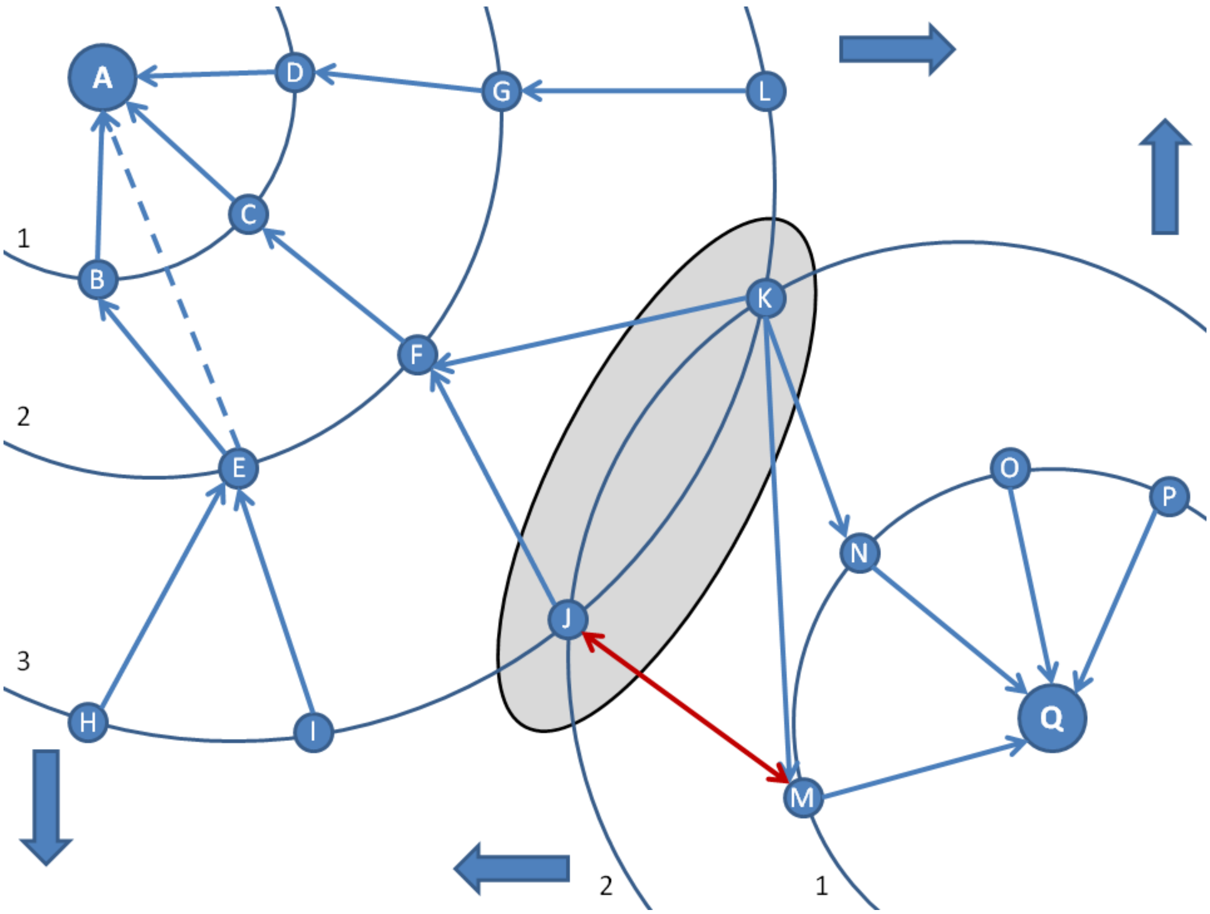

Figure 1. Conceptual model of online information ripples

A and Q are the two starting points of two separate information waves that meet in J and K in Figure 1 above. In physics when two waves meet two things can happen: 1) constructive interference (or superposition), or 2) destructive interference. Two things can happen when two waves with the same amplitude, frequency and length meet while travelling in a medium. If the waves are in-phase with each other when they meet they create a superposition of the wave which has the combined amplitude of the two waves. If however, the waves are out of phase when they meet they cancel each other out (destructive interference). When two information waves meet they can strengthen and amplify each other's messages or they can cancel each other out. Two news sources can cover some event from two different angles and when the waves of the news meet they can support each other and amplify the news or they can cancel each other out if they are contradicting each other. In scientific literature two articles can support each other's findings (possible in a third article) or they can cancel each other out by showing opposite results. Automated discovery of interference in information waves would however be challenging to achieve, as the recognition of how the two waves influenced each other would probably require some qualitative analysis.

Various methods from webometric research could also be used to analyze information ripples. In our model for online information ripples in Figure 1, K is co-inlinking to F and M, indicating a connection or a similarity between them. This would also mean that K has been influenced by both waves. H and I on the other hand are co-outlinking to E, indicating that H and I have a shared interest towards E or that E has influenced them in some way. J and M have a reciprocal connection as they are both linking to each other. Reciprocity may indicate a stronger connection between the people, websites, or tweets represented by the nodes in Figure 1. What exactly these connections and relationships between the nodes mean has to be investigated qualitatively by analyzing the content of the blog entries, tweets, news or articles represented by the nodes in the model.

Conclusions

People are sharing huge quantities of content and information to their online social networks and potentially the information and content shared can reach a great number of people. Blog entries, news and tweets get forwarded a lot, but the patterns of online information dissemination are not yet fully understood. The dissemination patterns may be different depending on who shares the content, what type of content is being shared and which social media it is being shared on. It is also unclear how we receive content and information and how we decide what to share forward with our online social networks.

The next step for this ongoing research is to empirically test the concept of online information ripples and to map the motivations to share information in social media. Information dissemination patterns will be analyzed on Twitter by collecting the tweets containing a certain hashtag. The data will then be analyzed using webometric methods, social network analysis and methods borrowed from physics. The motivations to share information on Twitter will be investigated by using an online survey.

In this paper we have presented the metaphor of online information ripples and showed how the metaphor can be used in information dissemination research. The metaphor of online information ripples allows us to study online information dissemination patterns as ripples or waves using methods borrowed from physics and with that the metaphor opens new possibilities to new discoveries using methods previously not used in information science. Using the metaphor may reveal some new information about how information is disseminated in social media and about our changing online information behavior.

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