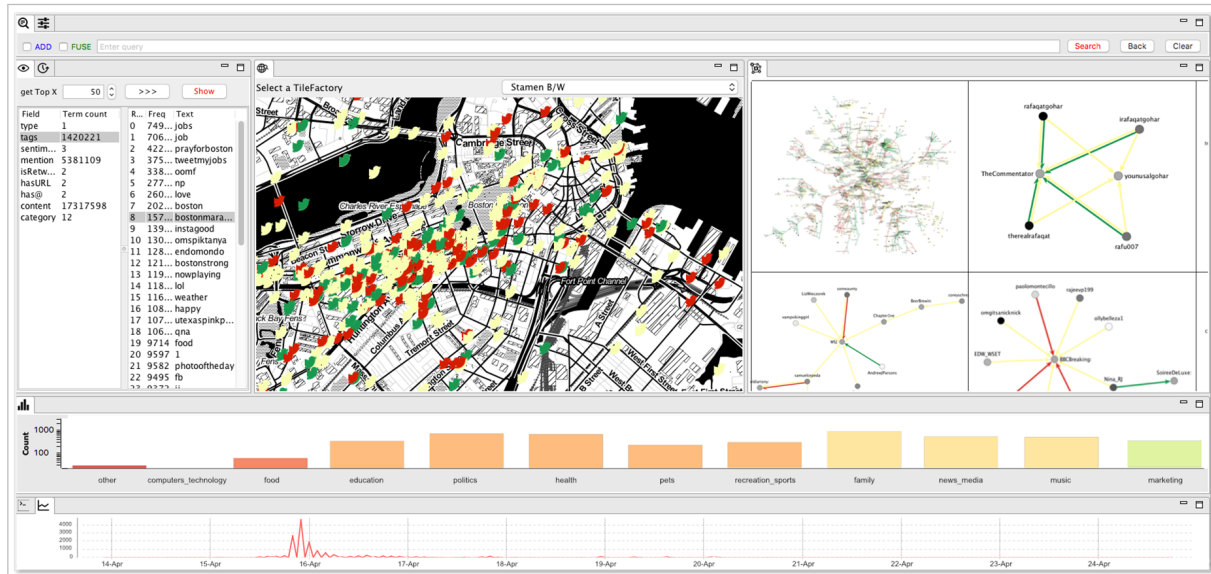


# Visual Analysis of Geolocated Echo Chambers in Social Media

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**Figure 1:** Main interface of our Visual Analytics tool that assists in the exploration of spatiotemporal echo chambers. This figure shows the analysis of tweets corresponding to the Boston Marathon bombing event that occurred on April 15, 2013.

## Abstract

In news media, echo chambers refer to situations in which information is amplified or reinforced by communication and repetition. The characteristic of an echo chamber is, therefore, the absence of controversial discussions and a narrow set of opinions about a topic. We propose the use of Visual Analytics to describe spatiotemporal distributions of echo chambers using Twitter data, for specific geolocated events, such as concerts, strikes, demonstrations, etc. We analyze the echo chambers for Boston Marathon Bombing that took place on April 15, 2013. The social groups are displayed by a matrix view containing all connected components of the tweet mention graphs. To identify similar opinions, as well as, the diversity of topics in a discussion, we apply text classification and sentiment analysis. Lastly, we present initial findings based on real-world data.

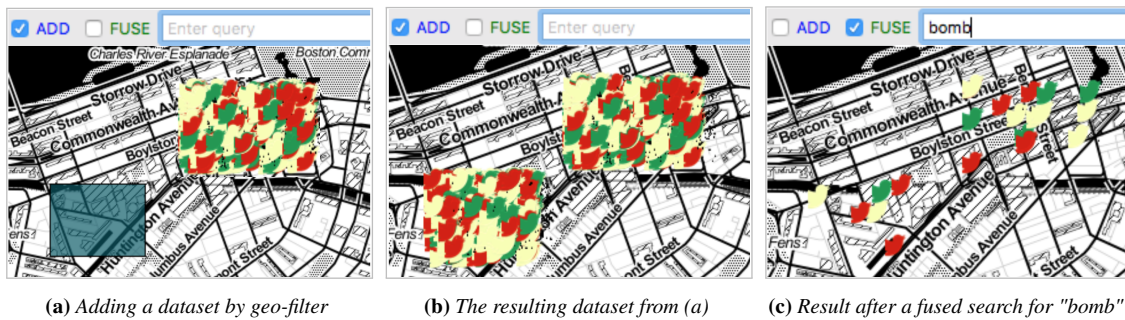
## 1. Introduction

Nowadays, there is a growing mistrust towards our traditional news media. News consumers are flooded with opinionated information while reporting from particular news agencies is influenced by pre-set agendas [McC01, WGL04]. In the context of social media as an information source, the factual accuracy and truthfulness for journalism represent a major challenge (see [Whi08] first principle).

We aim to capture the reputation and topic affinity of users [KMZL13] in social media and extract their geospatial context in order to understand how news about local event

groups spread geographically and temporally. Humans tend to read and share information that supports their own opinions and ideas [MSLC01]. The phenomena, that an input within a defined system gets repeated, confirmed, and amplified, is known as an echo chamber. Previous work states that social media, such as Twitter, can increase the effects of echo chambers [DG17].

We propose the design of a Visual Analytics tool to explore the geographic distribution of echo chambers, the confirmation biases on given news threads, the positive feedback spirals, and the cit-



**Figure 2:** The subfigures show the consecutive, interactive creation of a search space.

izens' appealing to a given topic depending on demographic and local news exposure.

## 2. User Credibility Scoring

We aim to analyze first-hand information from key eye-witnesses for a given event. This can include their spatial proximity to the event, the overall topic structure, as well as, temporal dynamics. Using geotagged tweets, we measure the average spatial proximity of a person to an event. This is combined with the tweet timestamp and user's topic affinity to identify credible eye-witnesses. In addition, the users' credibility score incorporates metadata such as retweet-counts, the number of posts per user, and other content analysis measures. Our credibility metric is aligned to the work of Castillo et al. [CMP11]. This scoring is computed per user and comprises the number of followers, the number of friends, the number of posted tweets, and the creation time of a user (how old is the user's Twitter account).

Future work will include the user's geographic proximity to an event and a topic affinity measure. In addition, the credibility of a tweet will adopt a heuristic that weights the content usefulness based on character repetition, the number of distinct tokens, and whether the tweet references valid URLs. Hereby, the extraction of URLs provides room for future domain link analysis.

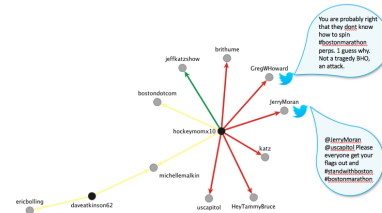
## 3. Visual Interface Design

Our Visual Analytics approach is tailored to the analysis of echo chambers based on contextual data coming from tweets. Figure 1 shows a screen-shot of the system. The ranking list allows the users to inspect the most relevant topics. A histogram with the topic distribution shows the average sentiment using a bi-polar colormap from positive (green) to negative (red). Both views enable users to compare the topic diversity within the analyzed dataset.

The central map panel allows for the analysis of the geographic distribution of the tweets. In order to select and filter tweets, users can query the database using a fulltext search, as well as geo-filtering. The *ADD* and *FUSE* functionality enables users to interactively build flexible search spaces, e.g., by selecting particular regions on the map, as shown in Figure. 2.

Moreover, our tool provides a view of the social groups in the graph matrix panel. These are all connected components of the

tweet mention graphs, i.e., user-tweet node-link diagrams (see Figure. 3). Users can filter one or more connected components as an echo chamber to be visualized on the map panel. The organization of the graph provides insight into the general structure of the echo chamber and its tweets. Hereby, the credibility score of every user is mapped to the brightness of its corresponding node. The color of an edge represents the sentiment value (negative, neutral, or positive) of the tweet. Using the brushing-and-linking of the coordinated views, users are enabled to explore all potential echo chambers and inspect details of their associated tweets.



**Figure 3:** Social Groups View. Each node represents a user and the brightness his/her credibility score. The edges represent tweets, while the edge directions indicate are mentions of the other users within the tweet. The colors red, yellow and green indicate its sentiment negative, neutral, or positive, respectively.

## 4. Use Case

We gathered two weeks of twitter data, before and after the Boston Marathon Bombing in 2013. In our use case, we filtered for #bostonmarathon to analyze the social groups. Beside smaller, more local connected-components where users chatter about the marathon sports event, a huge burst emerged when the bombing happened. This outburst was accompanied with a predominantly negative sentiment scoring of the associated tweets, indicating the disappear of users from this criminal act.

## 5. Conclusions

We presented the first prototype of our Visual Analytics system that allows users to analyze geolocated echo chambers using Twitter data. We propose a measure for the credibility of Twitter users. This is used for understanding the uncertainty of connected components in the mention graphs and indicated the overall reliability of the echo chambers. Future work will include the analysis of geospatial- and topic- proximity, and how they impact echo chamber polarization.

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