# USING INTERACTIVE VISUAL ANALYTICS TO ANALYZE INFLUENCES OF CLIMATE ON INDUSTRIAL PRODUCTION

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**ABSTRACT**

The paper discusses a solution to make methods of data analytics accessible to persons working in industry, who are not specialists in this domain. Small and medium enterprises should benefit from this approach.

**KEYWORDS**

Industry 4.0, swarm intelligence, information visualization, visual analytics, clustering

## 1. INTRODUCTION

A fundamental part of the project ISAC@OTH-AW (Gerlang 2017) is to cooperate with the local industry to generate innovations for the age of Industry 4.0. The project started at the end of 2015 and will last till the end of 2021. It is funded by the Ministry of Economics in Bavaria (Germany). Nowadays, in modern digital factories large amount of data are transmitted to interfaces for controlling and monitoring. Our industrial project partners appreciate that the next phase will be the analysis of data to get more insights in to the production process. There are several goals: improving product quality, saving energy, simplifying processes and more. Two partners are manufacturing plastic parts or parts made of foamed material and cardboard. They are collecting data from several sensors during the production process. The product quality is measured, too. They want to know whether atmospheric conditions would have any influence on the quality of their products. In our project, we designed new kinds of data logging devices. These devices are working independent form external power source for several months and are able to measure different climate variables every minute. At the time of writing this paper we are installing these devices inside and outside the factories. The goal is to collect data over a long time (one year). In combination with data form existing sensors and the measured product quality we will have enough data to find correlations of climate influences and product quality. The next problem is that often there is little knowledge about data analytics and machine learning in small or medium enterprises (Burns, 2015). Therefore, we want to provide a system that allows engineers to analyze data interactively without special knowledge. Though there are other interesting solutions (Liu et al. 2013), it is still not easy to make interactive visualizations of this huge amount of data, we implemented software that allows to resample data to different resolutions. It is possible to select the density and the time range.

## 2. INTERACTIVE CLUSTERING

Users are able to select parts of the whole resampled dataset with a range slider and get direct visual feedback (Figure 1). The visualization is divided in two parts: A plot of data below and a swarm-based visualization. Instead of using a flocking algorithm (Reynolds 1987) as proposed earlier (Meiller 2015) we decide to use a force-based algorithm (Battista et al. 1999). The similarity of two single data objects determines the strength of their attraction. Users are able to cluster data with an interactive k-modes algorithm (Meiller and Niewiera 2016). They are able to add and remove centroids interactively by touch or click complementary to the to the dynamic FClust approach (Saka, and Nasraoui 2010). The interactive way of selecting the amount of clusters should give more insight into the structure of data than other approaches where the number of clusters are

generated automatically (Shafeeq and Hareesha 2012). In future, we want to use our approach in combination with other methods of data analytics and machine learning to get best results for industry and to evaluate our approach.

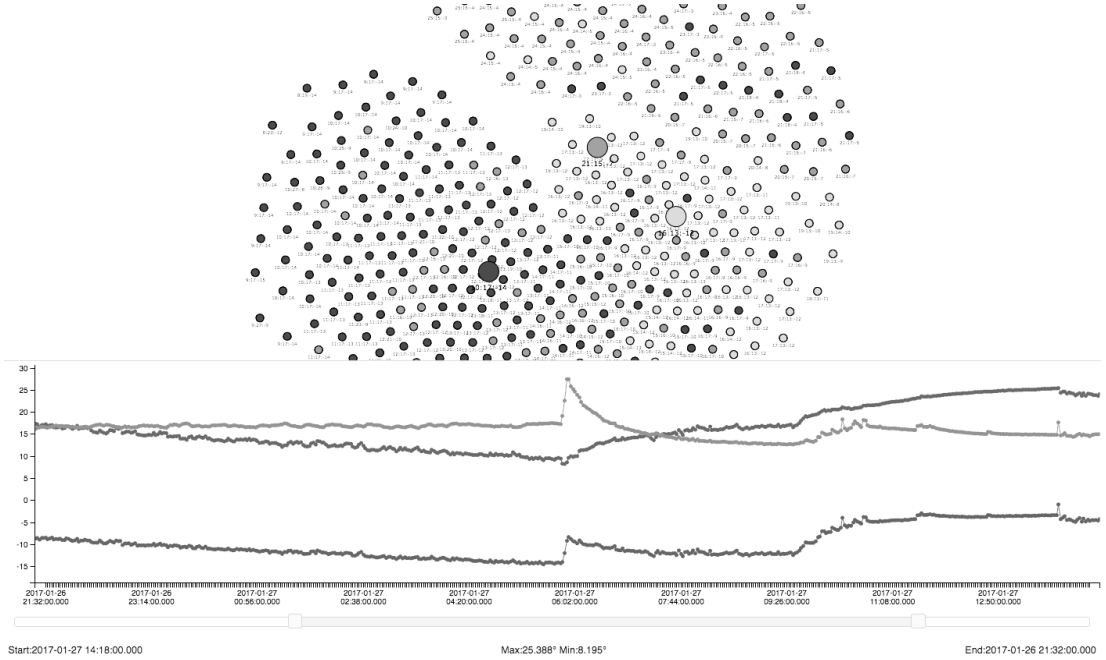


Figure 1. Screenshot of interactive clustering

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## REFERENCES

Battista, G. D. et al, 1999. *Graph drawing: algorithms for the visualization of graphs*.

Burns, E., 2015. Why haven't SMEs cashed in on big data benefits yet? *TechTarget*, [online] Available at: http://searchbusinessanalytics.techtarget.com/feature/Why-havent-SMEs-cashed-in-on-big-data-benefits-yet [Accessed 04 Apr. 2017].

Gerlang, B., 2017. ISAC@OTH-AW. *OTH-AW*, [online] Available at: http://www.isac-oth.de [Accessed 04 Apr. 2017].

Liu, Z. et al., 2013. imMens: Real-time Visual Querying of Big Data. *In Computer Graphics Forum*, Vol. 32, No. 3pt4, pp. 421-430.

Meiller, D., and Niewiera F., 2016. Data Visualization and Evaluation for Industry 4.0 using an interactive k-Means Algorithm. *In Conf. Proc. WSCG 2016 – 24nd International Conference in Central Europe on Computer Graphics, Visualization and Computer Vision*, pp. 33-37.

Meiller, D., 2015. Diving into the Data Ocean, *International Federation for Information Processing 2015, Interact 2015, Part IV*, LNCS 9299, pp. 465-468.

Reynolds, C. W., 1987. Flocks, Herds and Schools: A Distributed Behavioral Model. *In ACM SIGGRAPH computer graphics*, Vol 21, No.3, pp. 25-34.

Saka, E. and Nasraoui, O., 2010. On dynamic data clustering and visualization using swarm intelligence, *IEEE 26th International Conference on Data Engineering Workshops (ICDEW)*, pp. 337-340.

Shafeeq, A., and Hareesha, K.S., 2012. Dynamic Clustering of Data with Modified k-Means Algorithm, *International Conference on Information and Computer Networks (CICIN 2012)*, Vol.27, pp. 221-225.