

## **Persistence Diagrams in Probability and Statistics: From Materials TDA View- points**

Yasu Hiraoka, Tohoku University

Topological data analysis has been applied in materials science as a powerful tool for characterizing hidden geometric orders in disordered systems (e.g., [1]). Furthermore, some interesting mathematical problems have arisen through these applications. In this talk, I will give several these topics with connections to materials science. The first topic is in statistics, and a new kernel on persistence diagrams called persistence weighted Gaussian kernel (PWGK) will be presented [2]. I will show the advantages and the stability of our kernel, and furthermore demonstrate that the PWGK can successfully characterize the glass phase transitions. The second topic is in probability, and here I will discuss the convergence of persistence diagrams for stationary point processes [3].

[1] Y. Hiraoka, et al. Hierarchical structures of amorphous solids characterized by persistent homology. PNAS 113 (2016), pp. 7035–7040.

[2] G. Kusano, K. Fukumizu, and Y. Hiraoka. Persistence weighted Gaussian kernel for topological data analysis. ICML 48 (2016). pp.2004–2013.

[3] T. K. Duy, Y. Hiraoka, and T. Shirai. Limit theorems for persistence diagrams and persistence Betti numbers. In preparation.