Distributed algorithms for Euler Characteristic Curves (and Profiles)

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The Euler characteristic of a simplicial complex is the alternate sum of its Betti number, or equivalently the alternating sum of the number of its simplices of following dimensions. For a filtered complex the Euler Characteristic Curve is a function that assigns an Euler number to each filtration level. In the first part of this talk we will introduce the concept of ECC and discuss its stability with respect to the 1-Wasserstein distance. In the second part we will present new techniques to compute the ECC of filtered Vietoris-Rips or cubical complexes. By following a distributed approach, the contributions to the ECC can be computed locally without having to explicitly build up the whole complex. This allows us to significatively reduce both time and memory requirements, giving us the opportunity to tackle much larger datasets compared to, for instance, persistent homology. Such ideas and algorithms can be naturally extended to work in the multiparameter persistence setting, giving rise to the notion of Euler Characteristic Profiles.