Reducing the filter dimension: Applications to Streamline Visualisation

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Smoothness-Increasing Accuracy-Conserving (SIAC) filters for Discontinuous Galerkin (DG) methods are designed to increase the smoothness and improve the convergence rate of the DG solution through post-processing. These advantages can be exploited during flow visualization, for example by applying the SIAC filter to the DG data before streamline computations. However, introducing these filters in engineering applications can be challenging since a tensor product filter grows in support size as the field dimension increases, becoming computationally expensive. As an alternative, Walfisch et al. proposed a univariate filter implemented along the streamline curves. Until now, this technique remained a numerical experiment. In this talk we introduce the SIAC line filter and explore how the orientation, structure and filter size affect the order of accuracy and global errors. We show how line filtering preserves the properties of traditional tensor product filtering, including smoothness and improvement in the convergence rate, given an appropriate rotation. Furthermore, numerical experiments are included, exhibiting how these filters achieve the same accuracy at significantly lower computational costs, becoming an attractive tool for the scientific visualization community.