

# Tracking Features in Embedded Surfaces: Understanding Extinction in Turbulent Combustion

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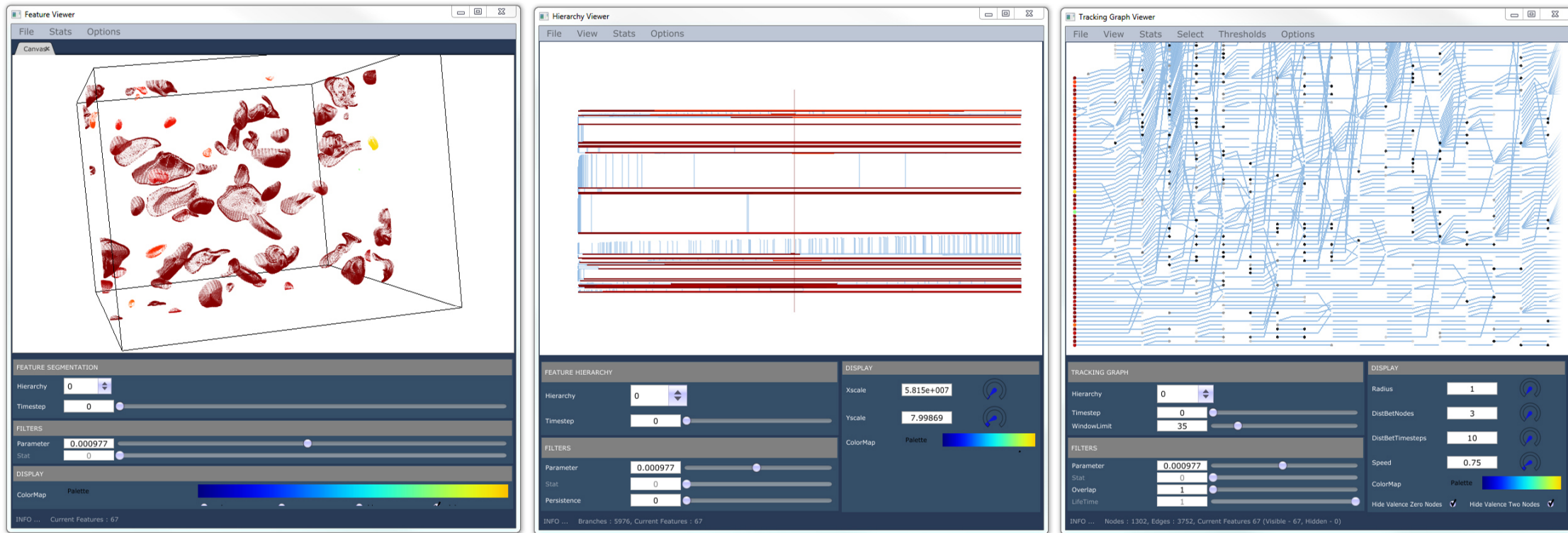
<sup>3</sup>Lawrence Livermore National Laboratory

Ankit Bhagatwala<sup>2†</sup>

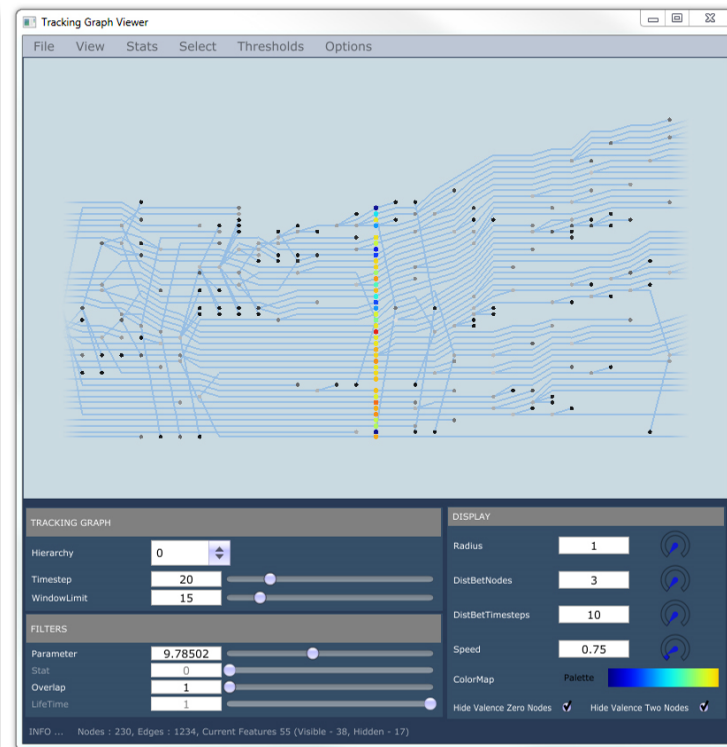
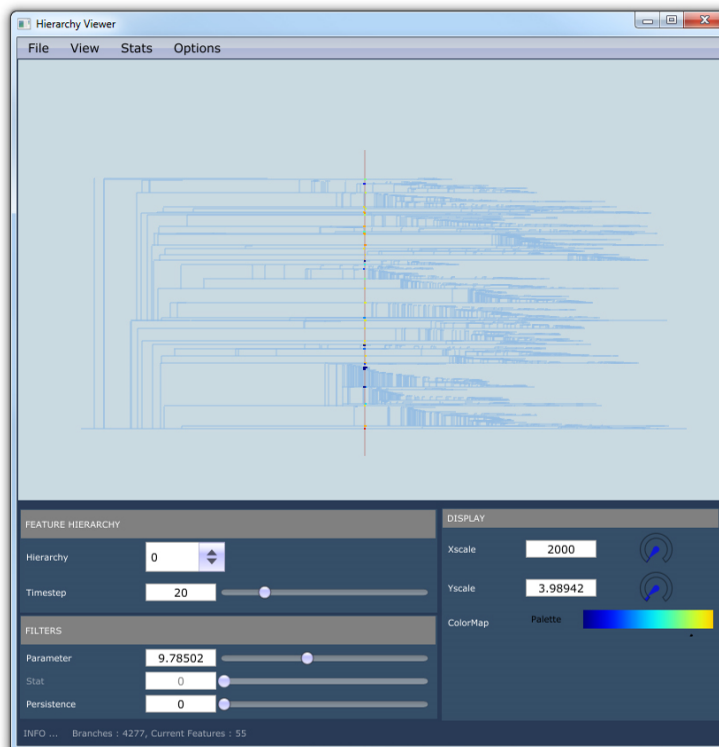
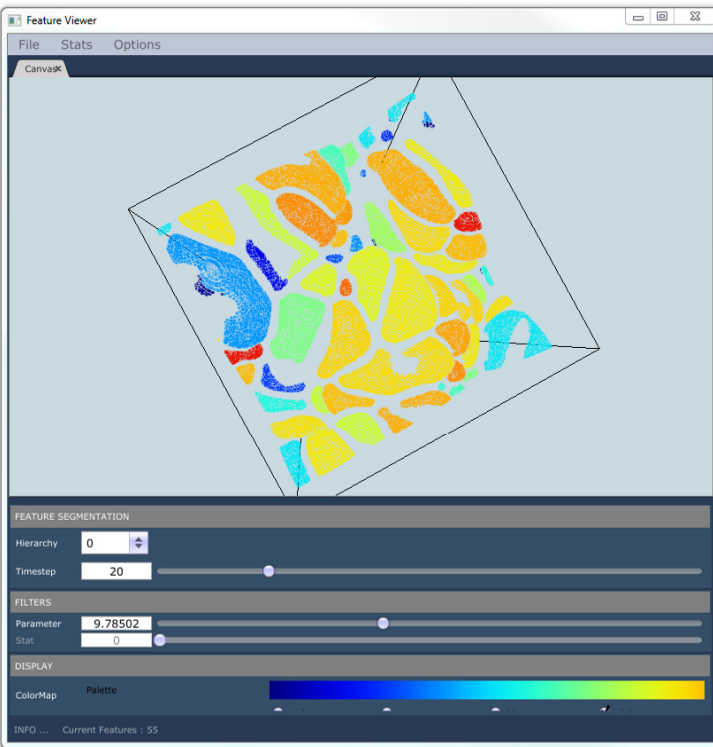
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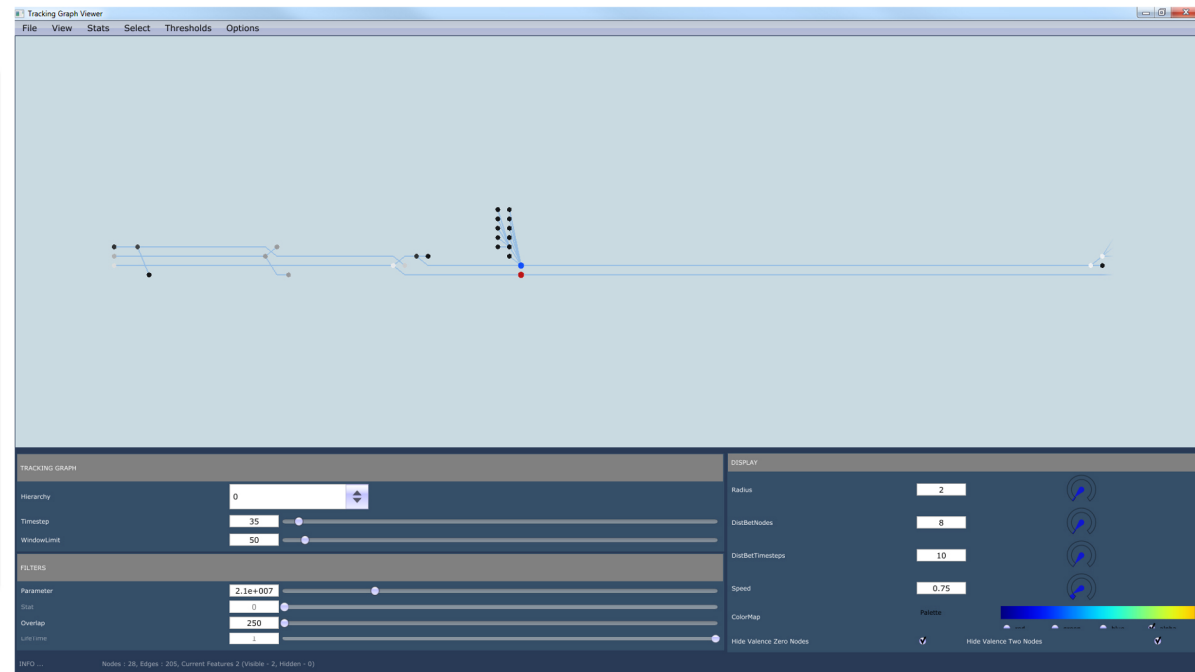
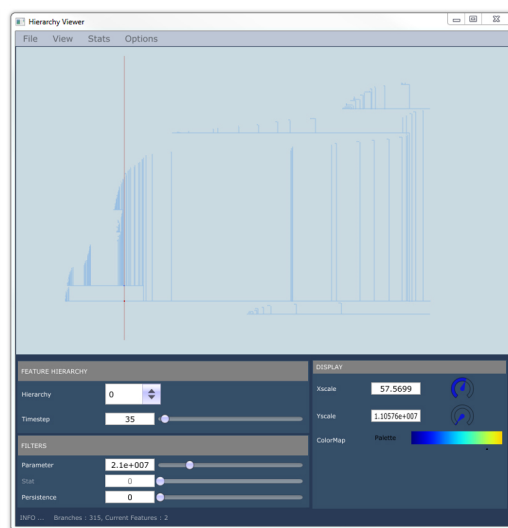
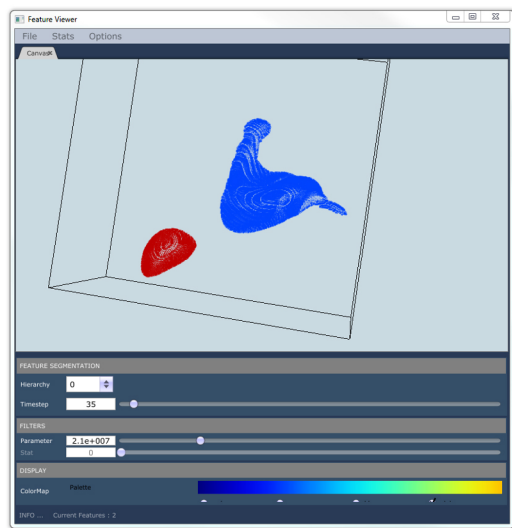
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**Fig. S.1. Our framework combines feature grouping and correlation components with visualization techniques to understand time-varying features of different types. Here, the turbulent jet flame data set is explored within the framework.**

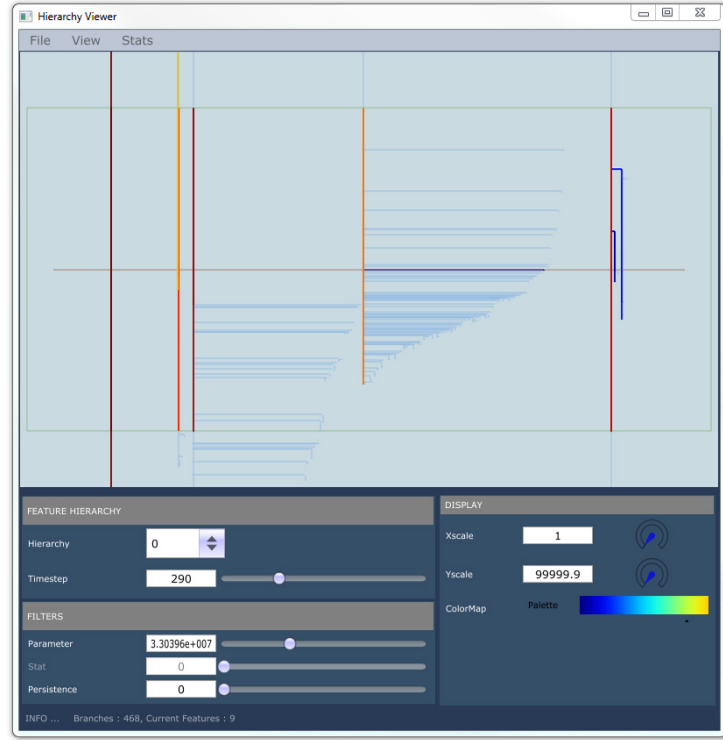
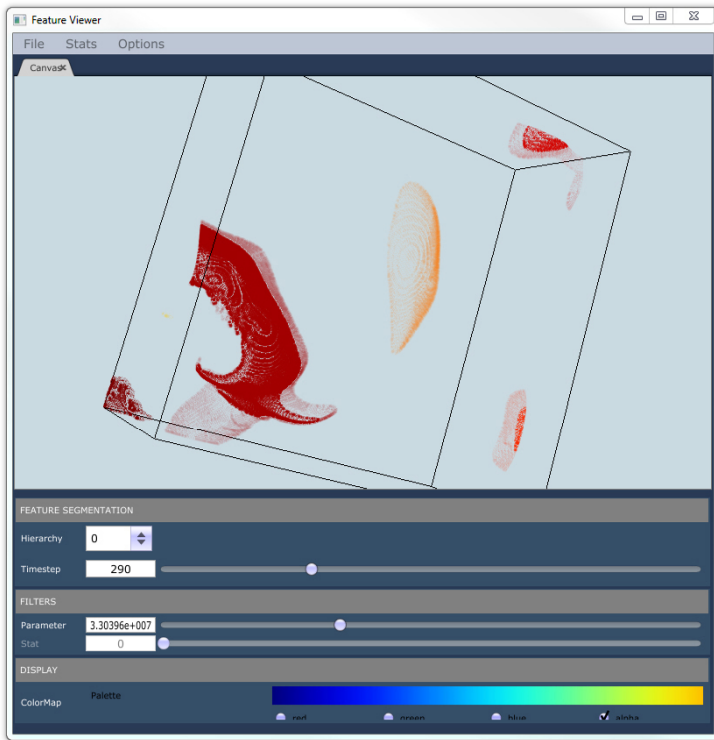


**Fig. S.2. Here, a tracking graph for the hydrogen flame combustion data set is visualized within our framework.**

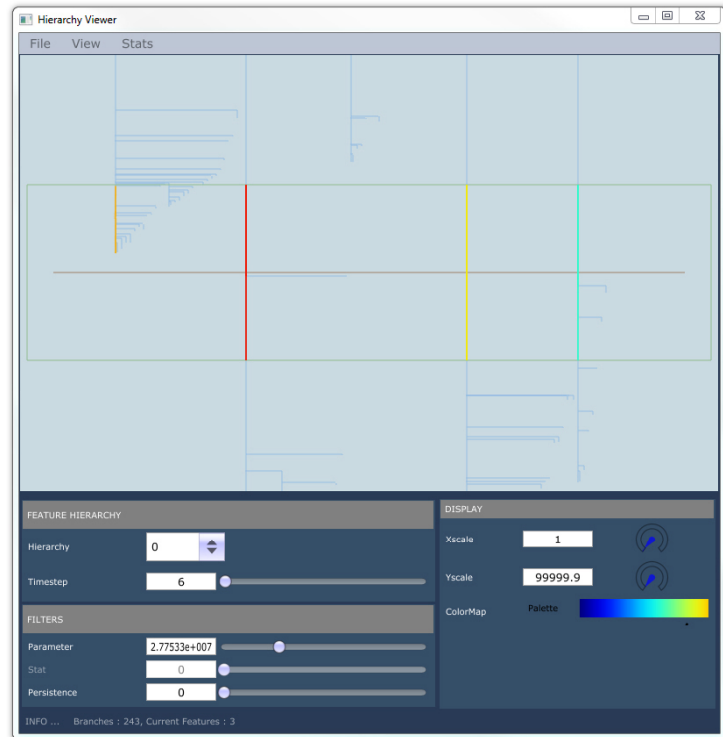
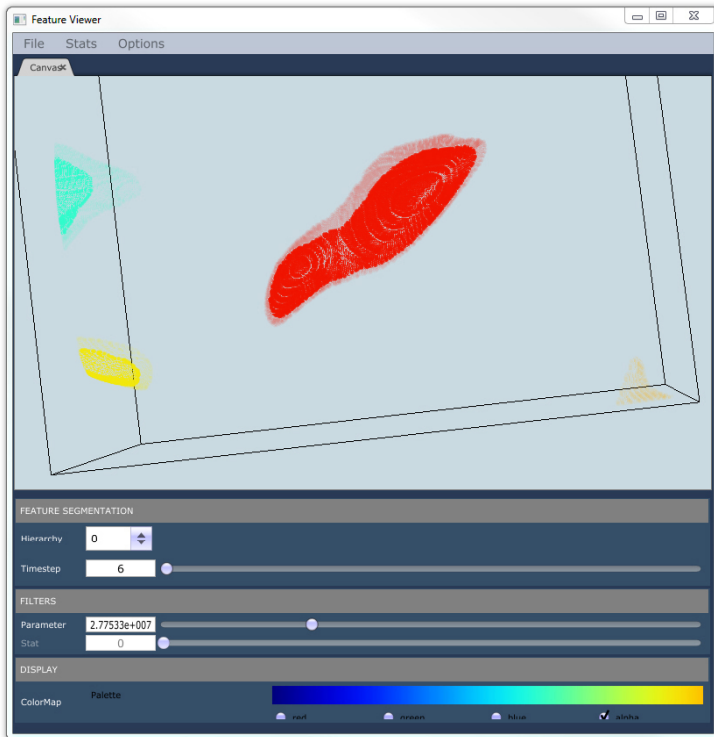


**Fig. S.3.** Here, a tracking graph for the counterflow flame combustion data set is visualized.

(a)

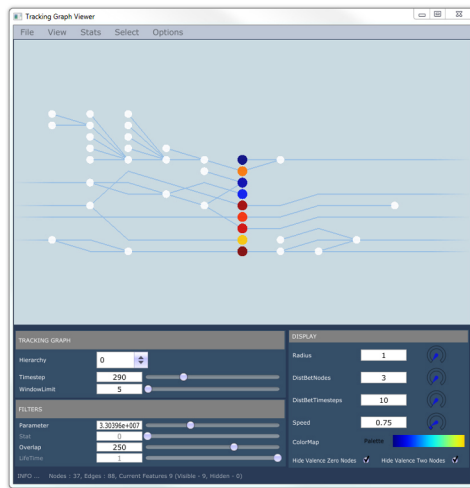
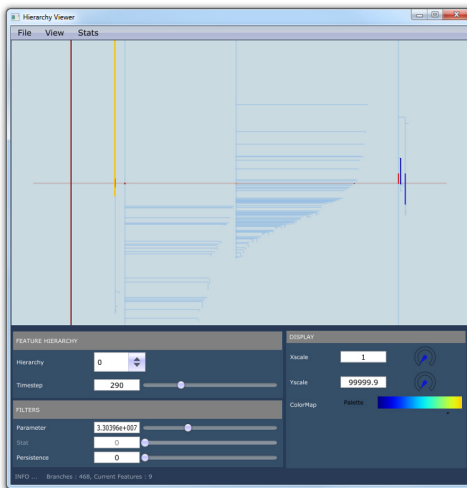
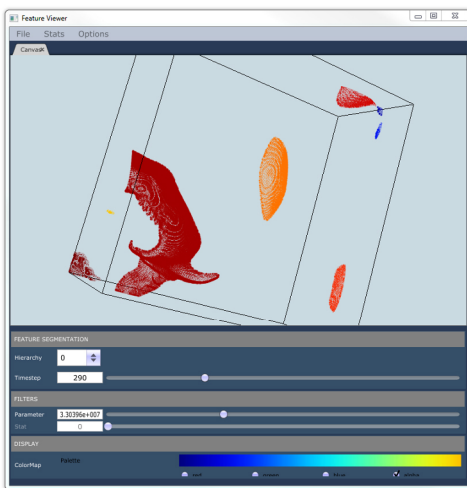


(b)

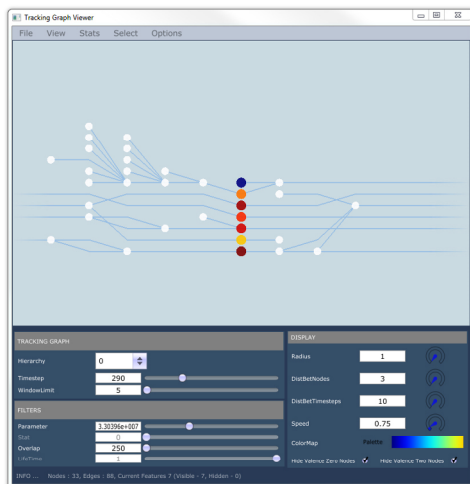
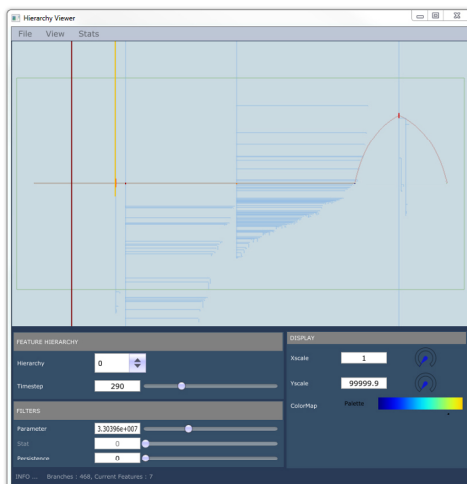
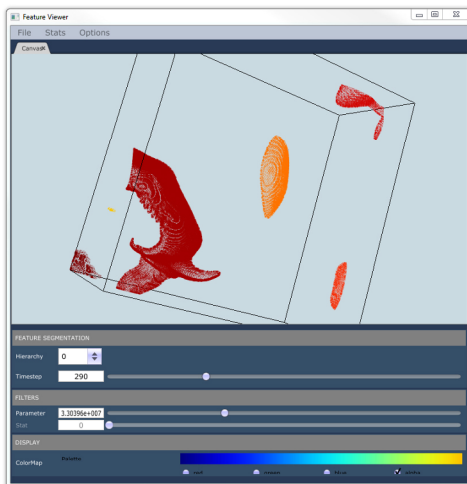


**Fig. S.4. Two examples where the user-defined parameter range and its range of outcomes are displayed within the feature embedding view (left) and feature hierarchy view (right). Within the feature embedding view, the finest features are in a higher opacity and coarsest in a lower.**

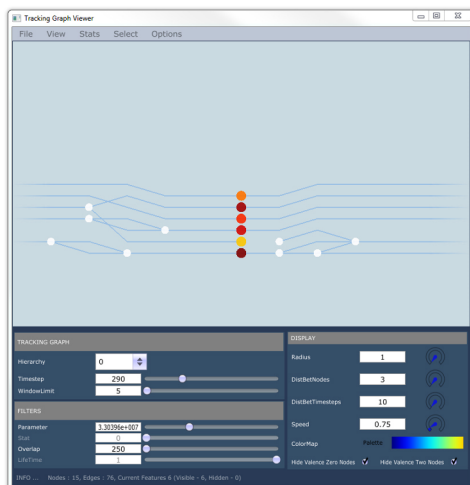
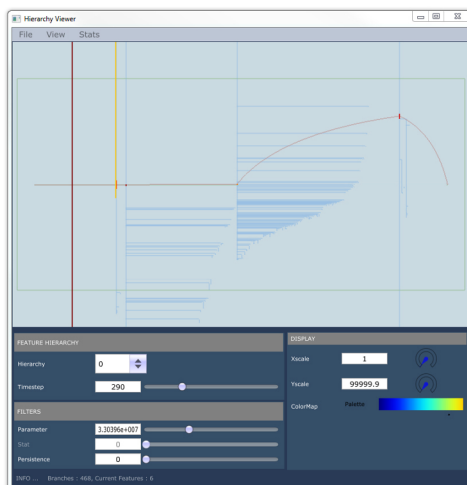
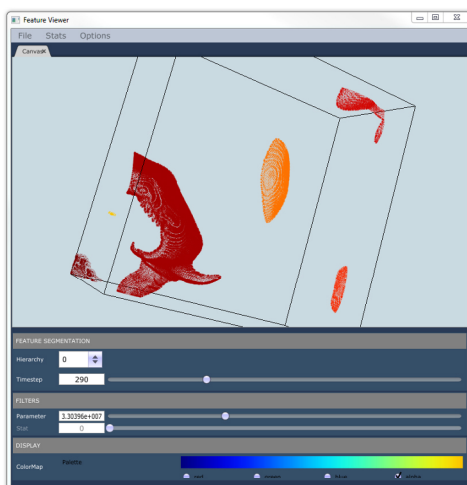
(a)



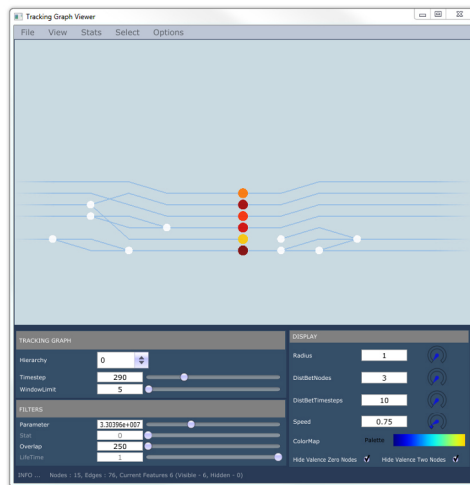
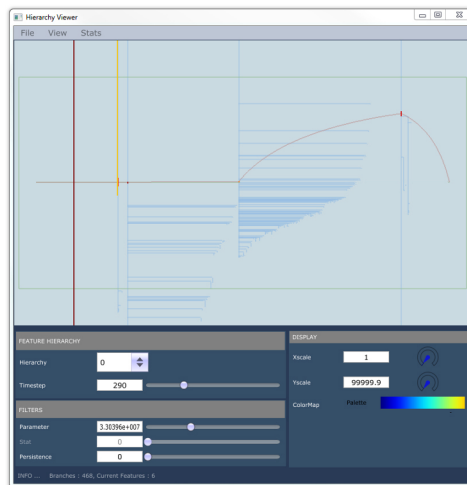
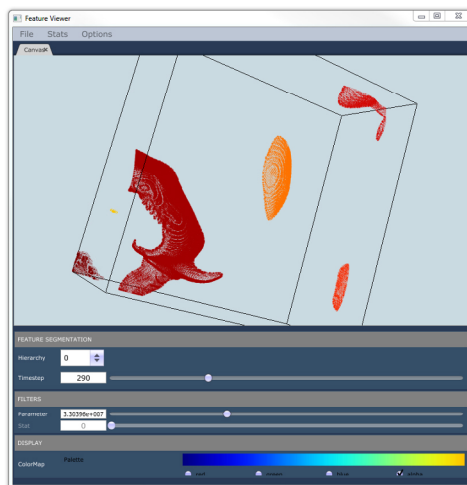
(b)



(c)

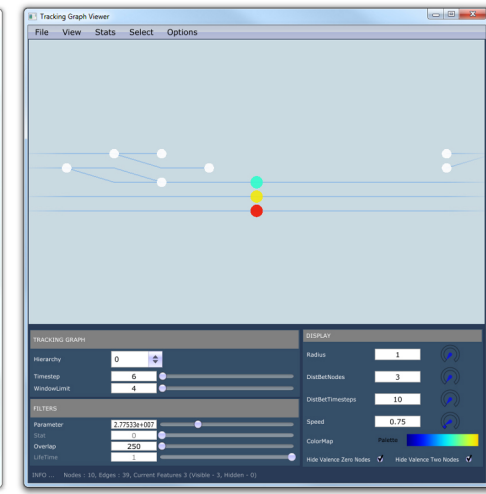
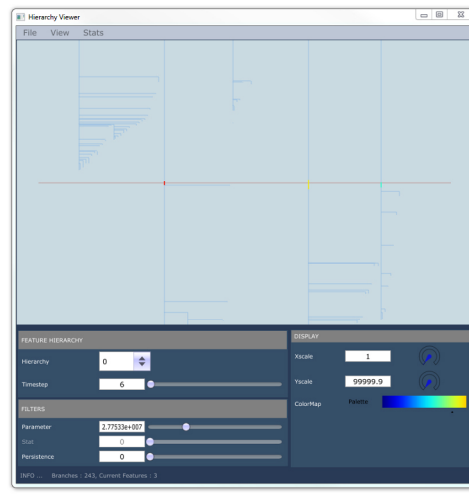
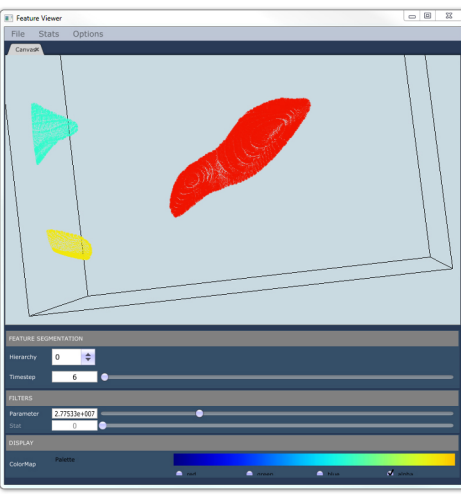


(d)

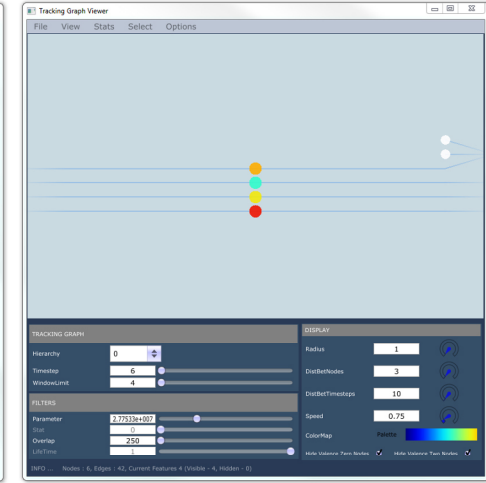
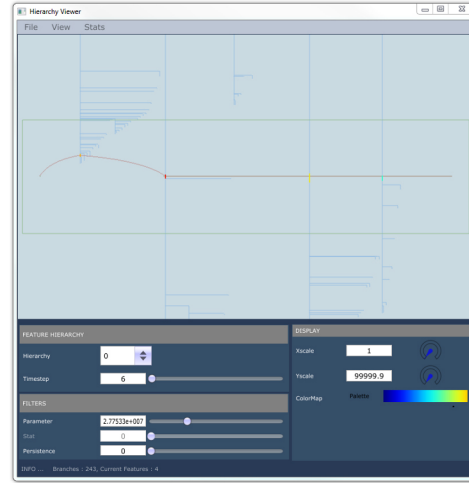
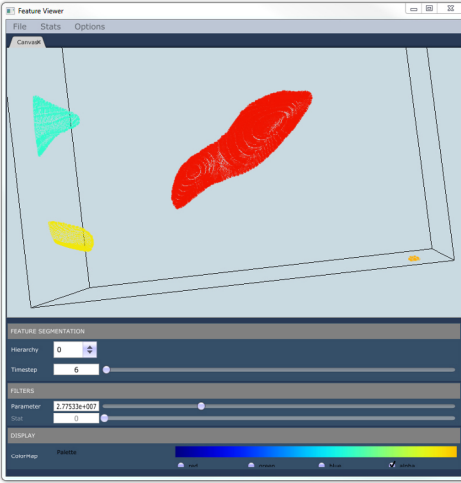


**Fig. S.5. An example where a sub-selected graph is further simplified using the proposed three-pass layout algorithm. The user-defined fuzzy range for this example is displayed in Fig. S.4(a). Here, (a) original graph, (b) graph after first pass, (c) graph after second pass, and the (d) final result are displayed.**

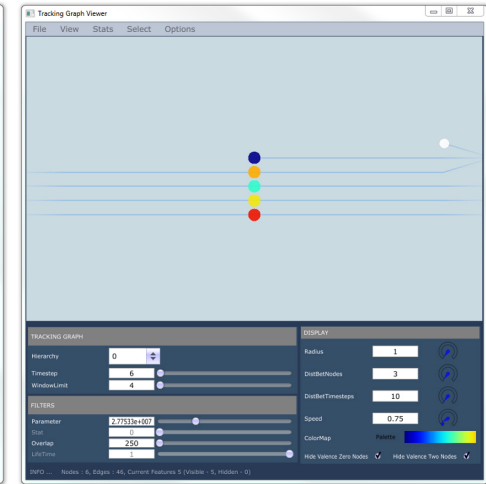
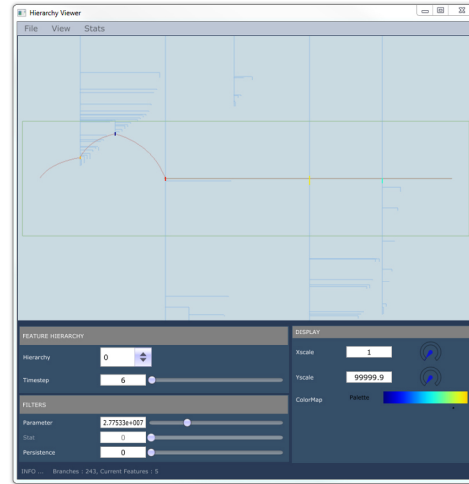
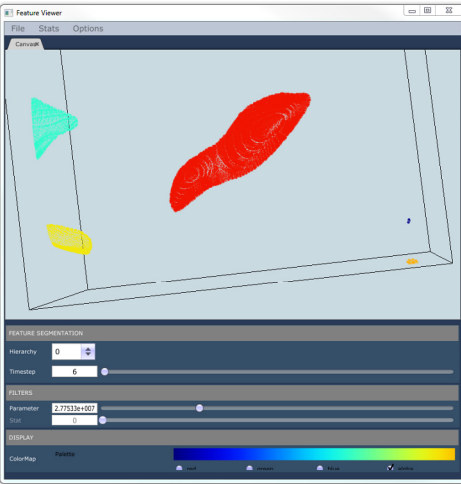
(a)



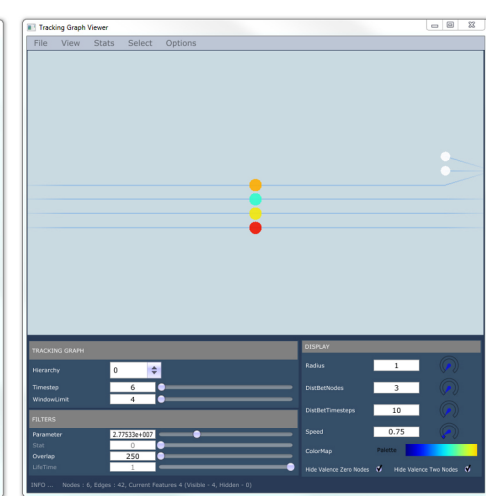
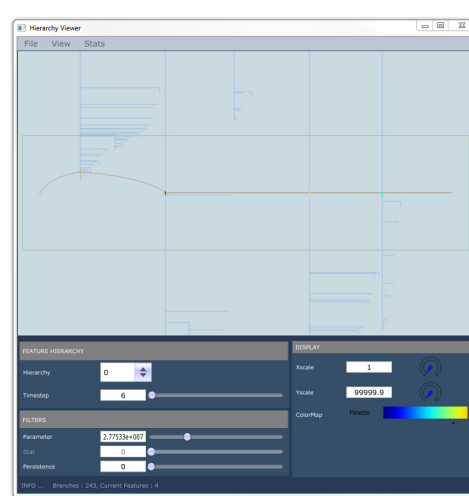
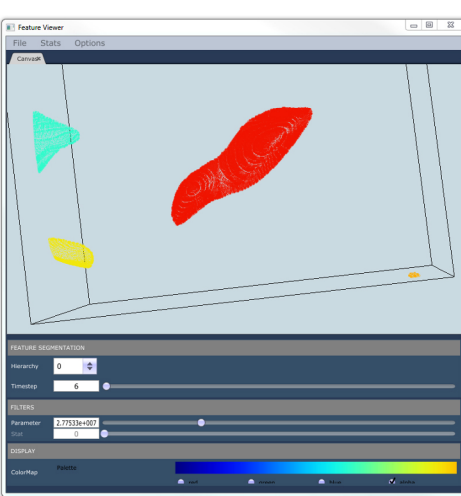
(b)



(c)

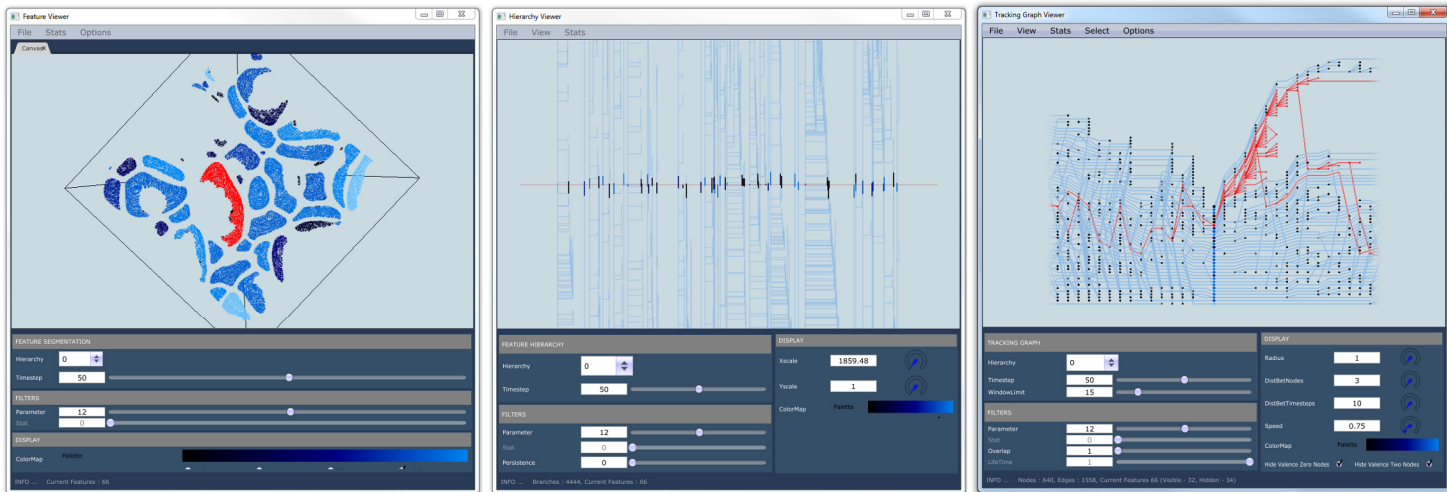


(d)

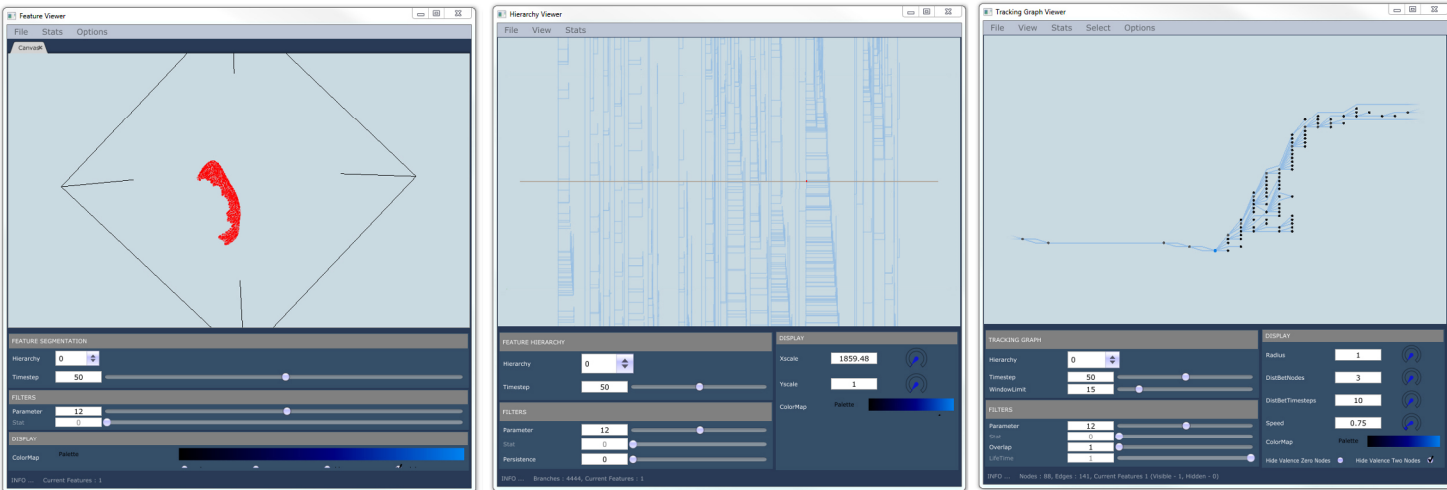


**Fig. S.6. Another example where a sub-selected graph is further simplified using the proposed three-pass layout algorithm. (a) The original graph is adjusted within the user-defined fuzzy range displayed in Fig. S.4(b), to produce (d). Both (b) and (c) shows the intermediate results of the algorithm.**

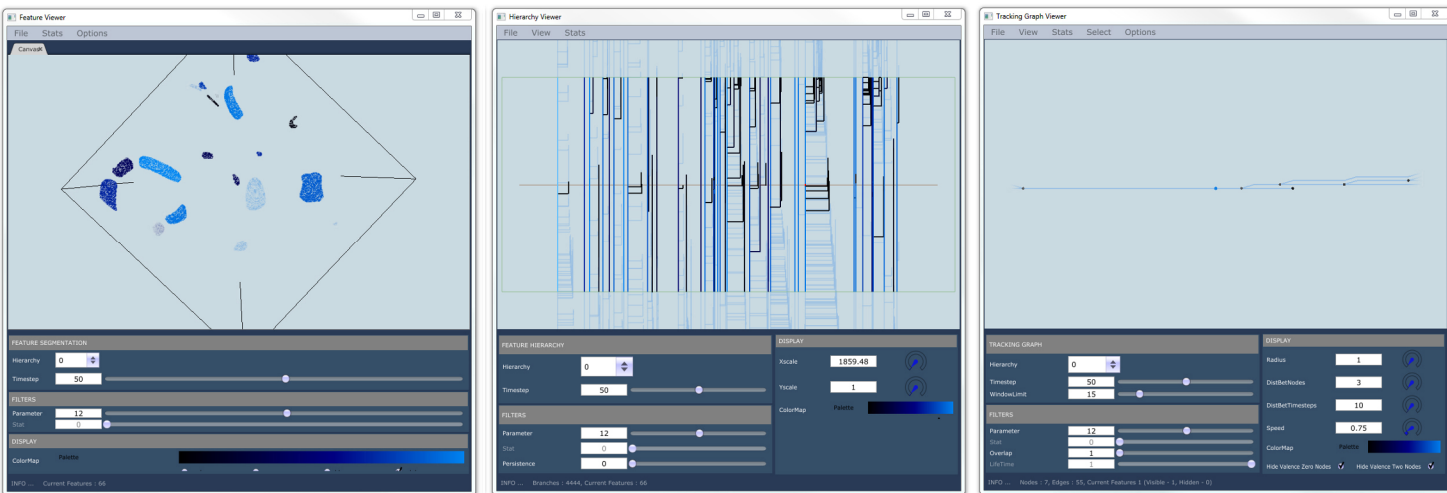
(a)



(b)



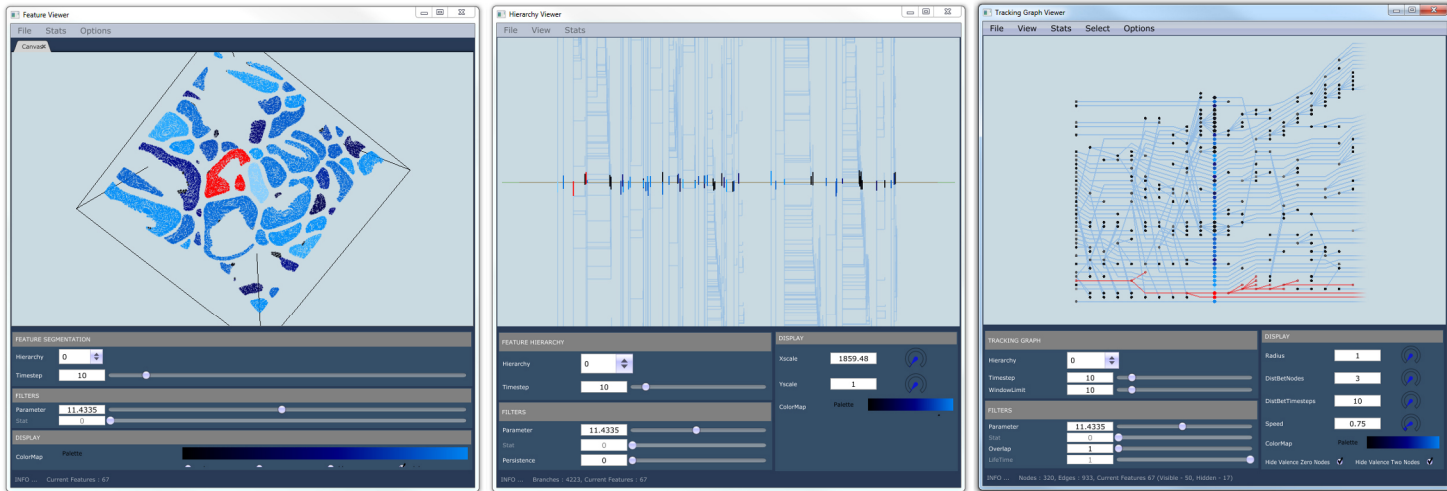
(c)



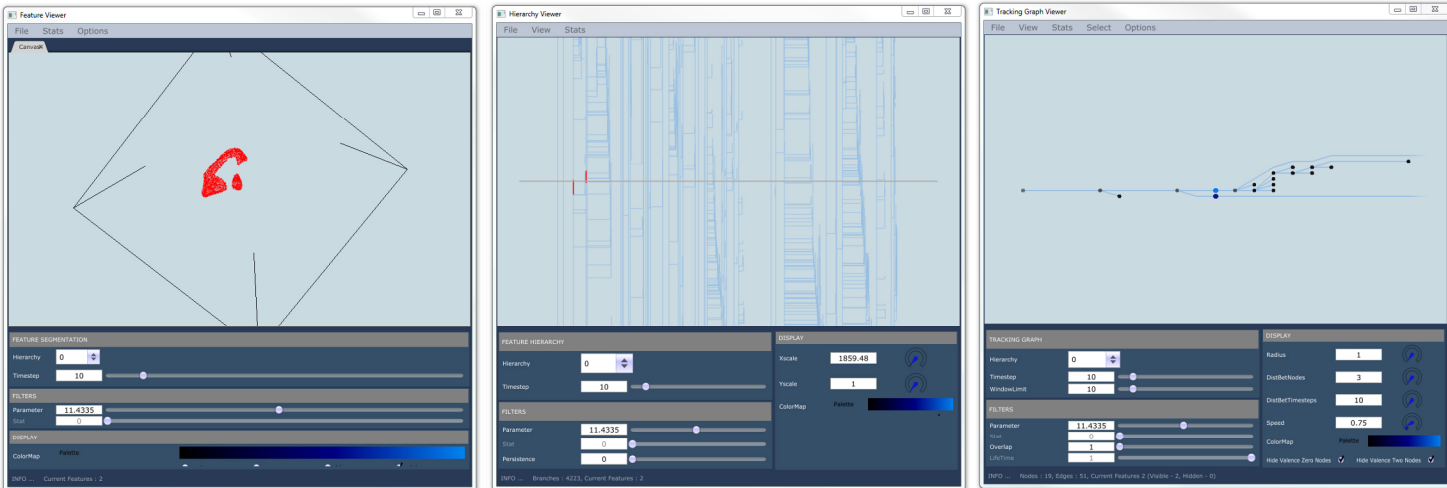
**Fig. S.7. Extracting local graphs for a set of focus features which are defined in terms of graph neighborhoods. (a) before and (b) after results of the tracking graph. The selected feature and its track is displayed in 'red'. The extracted local graph is further optimized within the user-defined parameter region, shown in (c) left and (c) middle, to result in a temporally cohesive graph, (c) right.**



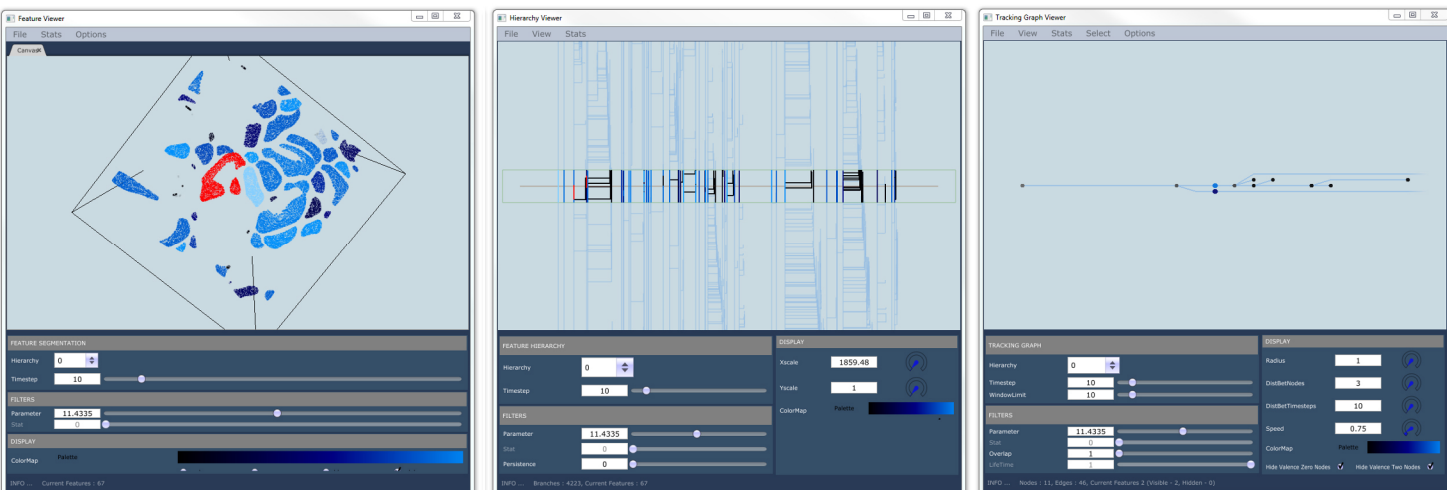
(a)



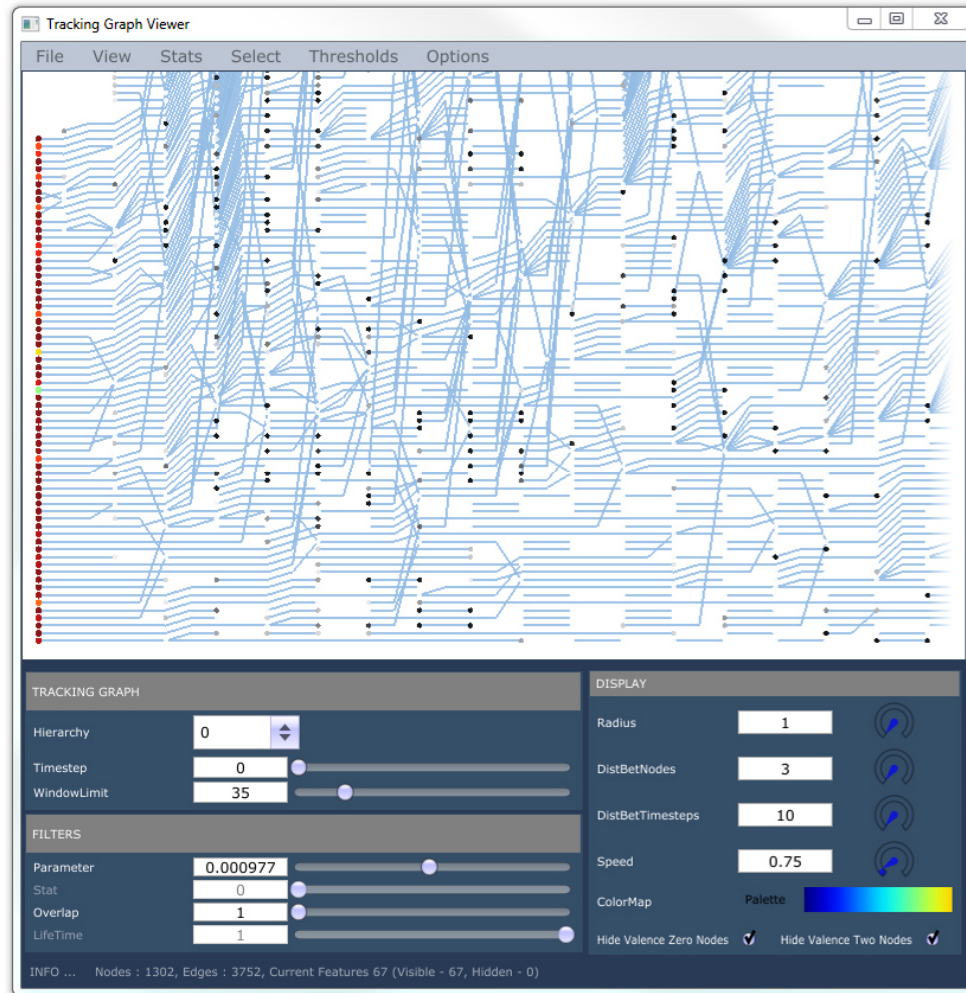
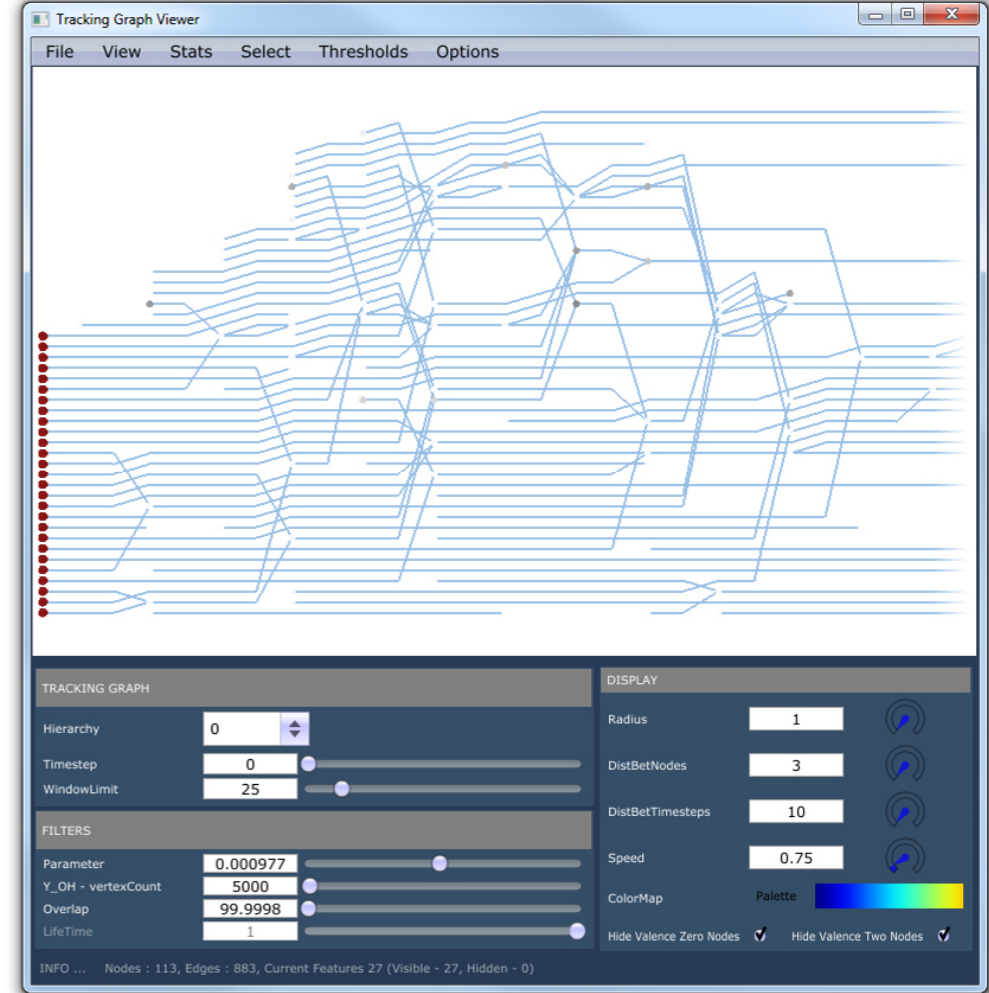
(b)



(c)



**Fig. S.8. Another example of extracting local graphs for a set of focus features which are defined in terms of graph neighborhoods. (a) before and (b) after results of the tracking graph. Again, the selected feature and its track is displayed in 'red'. The graph in (b) is further optimized within the user-defined parameter region, shown in (c) left and (c) middle, to result in a simpler graph, (c) right.**

**(a)****(b)**

**Fig. S.9. Filtering used on a tracking graph for the turbulent jet flame data set: (a) before and (b) after results of the tracking graph when filtered by the feature size ( $>5000$ ) and edge's similarity metric value ( $>100$ ).**