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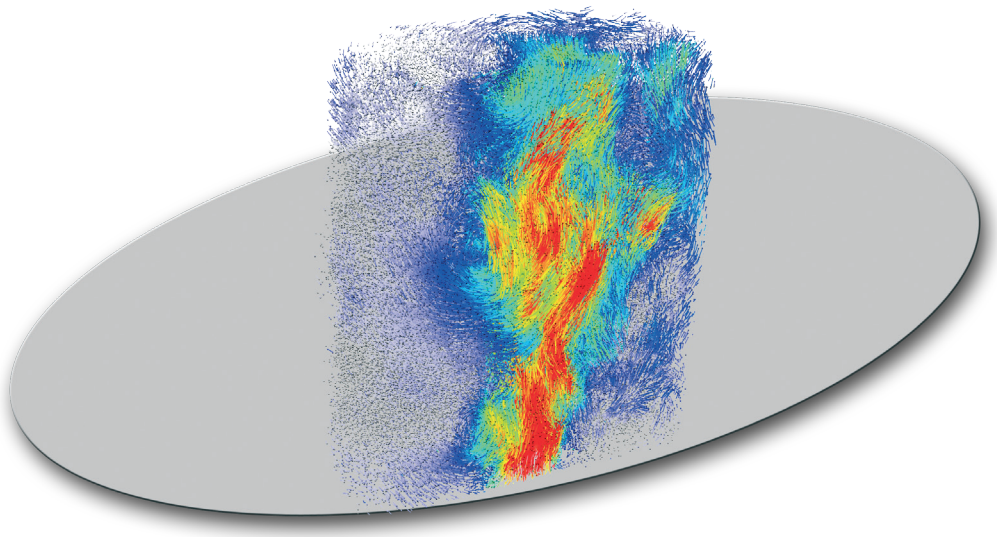
Multi-pass Shake-the-Box

LaVision's unique **Shake-the-Box** technique (developed in co-operation with DLR Göttingen*) is based on an advanced **Multi-pass** processing approach. In comparison to a standard single-pass implementation, the number of simultaneously tracked particles (up to several 100.000s) and the average particle trajectory length can be greatly improved.



Advanced Iterative Particle Reconstruction

Multi-pass Shake-the-Box relies heavily on LaVision's **Iterative Particle Reconstruction** method. As a result of many advanced implementation details and continous optimization efforts, LaVision's **Iterative Particle Reconstructions** yields high quality particle reconstruction results at minimum ghost particle levels with fast processing speeds.

Variable time-step approach for high dynamic range

For flows featuring high dynamic ranges and strong velocity gradients (e.g. jet flows, boundary layers), **Multi-pass Shake-the-Box** is improving the results of these difficult flow cases. By skipping several time steps of a recorded image set and setting individual velocity limits for each pass, the particle reconstruction and tracking is optimized for each area in the flow. This minimizes the occurence of ghost particles in slow speed regions and improves the overall tracking capabilities of the algorithm*.

*Schanz, Daniel und Novara, Matteo und Schröder, Andreas (2020) Variable-Timestep Shake-The-Box (VT-STB) for flows with high dynamic range. 3rd Workshop and 1st Challenge on Data Assimilation & CFD Processing for PIV and Lagrangian Particle Tracking, 19.-20.11. 2020, Online

Go forward and backward in time

The standard **Shake-the-Box** method converges to the final reconstruction solution after a certain amount of time. With higher seeding densities, this convergence phase can be very long and the resulting data density increases with the number of processed images. By going backwards in time and starting with the fully converged solution of the first pass, it is possible to extend the later added particle tracks into the earlier images of the set. Therefore, creating an equally dense reconstruction for the beginning and end of the entire measurement.

Data courtesy: DLR Göttingen

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Define your own STB recipe

Besides of pre-defined **Multi-pass** operation lists, it is possible to create customized **Multi-pass** processings with the help of several available pass types:

Invert pass
- change the temporal direction of the STB processing

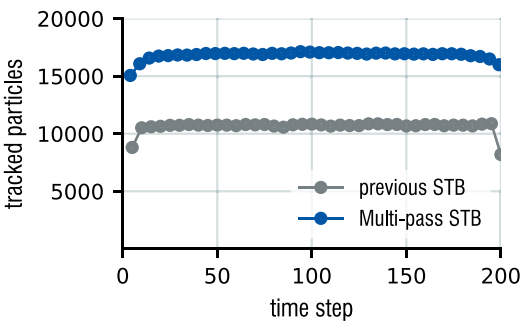
Range pass
- set specific ranges for different time steps and change the increment for variable time-step approaches

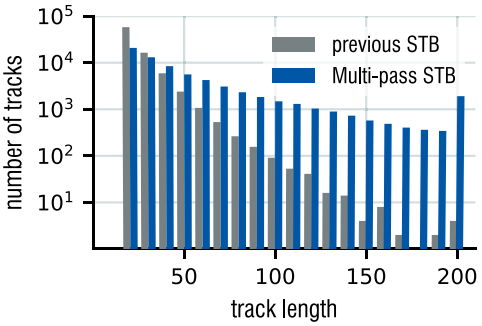
Reconnect pass
- repair interrupted tracks and yield longer trajectories

Custom pass
- fully customizable pass to further adjust the **Multi-pass** processing

Single-pass comparison

A comparison between our previous STB implementation in **DaVis 10.2** and the new **Multi-pass** evaluation is presented here for a typical flow measurement with LaVision's **MiniShaker** system.





Two major improvements of the **Multi-pass** method can be seen, here. Firstly, the number of simultaneously tracked particles for the **Multi-pass** approach clearly surpasses the number for the previous implementation. Secondly, the particles can now be tracked three times longer, on average, with the new **Multi-pass Shake-the-Box**.

Availability

LaVision's **Multi-pass Shake-the-Box** is available with the latest release of DaVis 10. It is applicable with time-resolved, 2-pulse and 4-pulse **Shake-the-Box** measurements.

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