

# Streams

Version 3.03

## Release Notes



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# I Fields

The following sections cover a number of changes to fields and their views in *Streams 3.03*. The user is referred to the *Streams 3.03 User's Guide: Field Objects* manual for full details regarding each of these changes.

## I.1 Persistent views

All graphical field views, if desired, can be retained within the field. Such views are termed **persistent**. All view settings are retained when the view is saved, so that, when the view is reopened, the view looks exactly as it did when it was saved.

Persistent views are saved with the field when it is saved to disk.

## I.2 Legend visibility

A number of field views display legends on the right hand side of the view. An example is the contour view of a Scalar 2D field. The user now has the ability to hide the legend if they wish. This option does not apply to 3D views.

This change does not refer to the legends that can be displayed when a view supports overlays. These legends have always had the ability to be hidden.

## I.3 Edge fields in field registry

In previous versions of *Streams*, when a view that supported the determination of edge fields – e.g. the contour view of the scalar 2D field – closed, the user was prompted as to whether they wished the edge fields to be retained in the field registry. In version 3.03 all edge fields are automatically saved in the registry and the user is no longer prompted to take this action.

## 1.4 Saving common view settings

All graphical field views possess a number of view settings that are common to all views of that particular type. These settings are controlled via a settings dialog box, and include such things as the font to be used, the size of the borders around the figure and various view colours. These common view settings can now be saved to disk so that they are easily reinstated at a later time. Note that when views are saved as persistent views these common settings are saved along with settings peculiar to the particular view.

## 1.5 Saving views as images

When a graphical view is saved as an image or image sequence the user has the option of choosing to use a transparent border in the saved image(s). Only some image formats support transparency (for example the .PNG format) and *Streams* will not use the transparent border unless the format supports it.

# 2 Particle Tracking in 3D

The following sections cover a number of changes to particle tracking in 3D. The user is referred to the *Streams 3.03 User's Guide: Core Objects* manual for full details regarding each of these changes.

## 2.1 Predict and verify technique

In earlier versions of *Streams* a single technique was available for the construction of 3D particle fields from particle 2D record bundles. This technique, known as bundle matching analysis, shared many similarities with the particle tracking algorithms.

In *Streams 3.03* a second technique has been added. This technique is referred to as "predict and verify". It utilizes similar tools to the bundle matching analysis technique but takes an alternative approach to the construction process. Particles in 3D are first predicted using two

perspectives within a bundle and then the remaining perspectives are used to verify the particles. Unlike the bundle matching process an optimization process is not employed in the prediction step.

Our limited experience of these techniques suggests that the predict and verify technique is the more reliable.

## 3 Tablets

A number of changes have been made to tablets in *Streams 3.03*. In addition, because of their growing capability an entire manual has been dedicated to them. For all information on tablets, including the changes listed below the user is referred to the *Streams 3.03 User's Guide: Tablet Objects* manual.

### 3.1 New data types

Two new data types have been added to the four previously supported by tablets. In addition to fields, grids, matrices and scalars, the user can now manipulate **strings** and **custom functions**. While strings have limited usefulness the custom functions provide the user with the valuable ability to construct bespoke functions that can produce scalar or vector fields.

These functions may be created in two ways. The first, involves the specification of mathematical formulae – or a single formula in the case of a function that produces a scalar field – that express the functional forms. These formulae are consistent with mathematical formulae that appear in other areas of the *Streams* environment – e.g. custom calculators. The second method is to create the functions via a tablet function. One such function, see section 3.2, is available to generate a least squares best fit function to a 2D surface. This function is a custom function.

Custom functions can be used in appropriate places in tablet commands. For example, calling a custom function that takes a grid as a parameter will generate the desired field based on that grid.

The analysis view of a tablet now possesses two additional tabs that list the strings and custom functions defined for that tablet.

### 3.2 Tablet functions

A number of new functions have been added to tablets.

**LeastSquaresSurfaceFit()** computes a least squares fit to a 2D surface using polynomial basis functions up to order 3. It takes matrices of the coordinates of the surface being fit and returns a matrix of polynomial coefficients.

**LeastSquaresSurfaceFitFunction()** performs a similar task to the **LeastSquaresSurfaceFit()** function but in a more useful form. It generates a custom function that represents a least squares polynomial fit to a 2D surface and has no limit on the order of the basis functions. This function can be extremely useful for producing mapping transformations for particle 2D records that arise when the camera characteristics are such that a simple linear scale for mapping pixel to physical coordinates is not appropriate. The custom function can be dragged and dropped into the details view of the mapping transform for ease of transfer.

**HighPassFilter()**, **LowPassFilter()** and **BandPassFilter()** allow filtering of 1D scalar fields. A number of filter types are available.

A set of general functions that provide access to different characteristics of fields, grids and perhaps matrices, have been introduced. These are **NumDims()**, **DimStep()**, **DimOrigin()**, **DimSize()** and **DimLabel()**. The purpose of each should be self-explanatory.

The two cross-correlation tablet functions – **Crosscorrelate1DScalarFields()** and **Crosscorrelate2DScalarFields()** – now allow for both positive and negative offsets in the correlation dimension.

## 4 Lagrangian Path Fields

Substantial changes and additions have been made to the Lagrangian path field 2D. Details of the changes can be found in the *Streams 3.03 User's Guide: Core Objects* manual.

## 4.1 Views

The default view for a Lagrangian path field, whether 2D or 3D, is now the calculator view, not the path view.

The spatial and temporal units are now editable in the details view.

Changes have been made to the path view that provide the user with somewhat more control over the information displayed in the view.

The path list view now supports a range sorting options.

## 4.2 New calculators

**Relative position calculators** have been added to both the 2D and 3D Lagrangian path fields as part of their default calculator suite. These calculators subtract the initial x, y or z location in each path from subsequent path coordinates. Thus these calculators produce the displacement relative to the starting position of each path. A relative total displacement calculator is also provided.

**Two path calculators** provide users with the capability to mimic traditional measurement devices by computing quantities, such as strain, from two selected paths. Thus every pair of paths can be treated as a measurement device.

## 4.3 Displacement field creation

Two-dimensional displacement fields now can be computed from 2D Lagrangian path fields. The creation process almost exactly mimics the creation process based on a particle 2D record. However there are significant advantages in using the Lagrangian path field instead of the particle record for this process as it is, in structural applications, at least almost invariably less noisy.

## 4.4 Transform pipelines

**Transform pipelines** are now provided for 2D Lagrangian path fields. Only three transforms are currently available. One of these aims to cater for the removal of camera movement by providing for the transform of all particle coordinates.

## 4.5 Popup menu

Both 2D and 3D Lagrangian path fields provide options in their popup menus that **create copies** of the path field. The copy does not include the processes of the path field, neither does it include fields computed by the calculators in the original path field.

# 5 Particle Records

Details of the changes to particle records can be found in the *Streams 3.03 User's Guide: Core Objects* manual.

## 5.1 Popup menu

Both 2D and 3D particle records provide options in their popup menus that **create copies** of the particle record. The copy does not include the processes of the original record.

## 5.2 Deletion of random particles

It is now possible, through a popup menu option, to delete a set of random particles from a 2D or 3D particle record. The user specifies the proportion of particles in each frame to delete, although because a random number generator is used to decide whether a particle is to be deleted or not, the exact number of deletions may not exactly match the proportion chosen.

Particle deletion is not treated independently for each frame in the record. Instead, a set of particles in the first frame is identified for deletion, and those particles and all of their matches in subsequent frames are removed. Thus whole particle paths are removed. The number of particles that must be deleted from frame 2 is modified based on the number already deleted through matches to frame 1 particles. And so the process continues throughout all frames.



## 5.3 Views

The particle view of a 2D particle record enables the user to **display nearest neighbours** (particles) to any point within the particle domain. This may be useful in understanding the performance of the interpolation processes employed to create Eulerian time series objects from the particle record, as these processes may utilize least squares fits to the data at the nearest neighbours to a grid point.

## 5.4 Processes

A new transform for 2D particle records is available within a transform pipeline. The **transform coordinates** transform provides general support for transforming the coordinates of the particles within the record. It has a similar aim as the remove camera movement transform but it provides for both translation and rotation of the particles. Thus it is seen as a superior option.

**Filter particle pipelines** are a new process available for 2D particle records. The filters provided in these pipelines are intended to provide more sophisticated methods for eliminating spurious particles from a particle record. Currently only one filter has been implemented – the **delete tracked regions** filter. This filter deletes particles within regions that move through time.

# 6 Manuals

*Streams 3.03* has introduced a new object type, known as a **manual**. *Streams* does not provide an on-line help facility, but it does provide extensive user help through its four manuals. To make access and navigation of those manuals easier, *Streams* now enables the user to load any of these PDF files directly into the application itself. Once loaded the PDF file is referred to as a manual. The user can open, close, and view the manual, and a number of simple navigation tools are provided in the reader view. In addition **bookmarks** are supported. These bookmarks enable the user to mark a particular page to facilitate a return to that page at a later time. Bookmarks can be saved to file and reloaded during a subsequent *Streams* session.

In reality the manual facility supports the viewing of any PDF file.

## 7 Mathematical formulae

Details of the changes to mathematical formulae can be found in the *Streams 3.03 User's Guide: Core Objects* manual.

### 7.1 Drag and drop support

Mathematical formulae arise in many parts of the *Streams* system – for example, filters, costings, various model creation processes and tablets. *Streams* now supports drag and drop of these formulae from one location to another. This has already been referred to in section 3.2.

Mathematical formulae can now include the constants PI and pi.

## 8 Free processes

A number of free processes associated with 2D Lagrangian path fields are now available.

### 8.1 Overlay path fields

Lagrangian path fields can now be combined with **overlay Lagrangian path fields** process. This process mimics that for particle records. A number of path fields are selected by the user and each can be offset in space and time relative to the first of the selected path fields.

### 8.2 Transform generation

Both 2D particle records and 2D Lagrangian path fields support a transform coordinates transform that enables particle coordinates to be transformed through time dependent rotations and translations. Two free processes have been implemented to generate these transforms from Lagrangian path fields. In each case these processes generate the

transform by finding the best transform, in a least squares sense, that maps one set of particles onto another set of particles.

The first process is called the **transform from one path field 2D** process. It computes the transform that will map the particles in each path in the path field at each time step back to the particles in each path at the start time. The second process is called the **transform from two path fields 2D** process. It assumes that two different path fields represent the same set of particles and deduces the transforms that map the particles at each time in one path field back onto the particles at the same time in the other.

## 9 Application

The *Streams* application now provides a new view, called the **diagnostics view**. It is intended for use by the developer to monitor the internal workings of the application by displaying diagnostic messages generated within the application. It may be of interest to the user if they are encountering bugs and wish to communicate them to the developer. The comprehensiveness of the diagnostic reporting will increase with time. Currently it is minimal.

## 10 Miscellaneous

In addition to the numerous additions to *Streams* described in the previous sections *Streams 3.03* includes numerous minor bug fixes. These will not be listed here.