Release Notes for Streams 3.01

November 2018 – Roger Nokes

1. Enhancements

Streams 3.01 includes a number of significant upgrades to the Streams system. The primary changes have been the inclusion of further support for 3D systems analysed using 3D PTV, additional field views and functionality, and additional functionality within Tablets.

1.1 Three dimensional Displacement Fields

With an eye to extend Streams capability into other scientific areas, notably material testing such as structural mechanics and pavement engineering, Streams 3.01 now includes support for 3D displacement fields and 3D displacement fields on a surface. The first of these is a logical extension to the 2D displacement fields in earlier versions of Streams, enabling particle tracking in 3D space and the computation of displacement and strain fields in 3D. It is analogous to a 3D velocity field.

However, in most practical applications in the materials testing domain, the materials involved are opaque and particle movement, while in 3D, occurs on a surface which moves in 3D space. Buckling of a steel beam is an example. Streams provides support for analysing such 3D/2D data through the provision of 3D surface displacement fields. However it should be noted that these fields are limited in certain ways. In particular complex surface geometry is not supported. It is assumed for these fields that the surface is primarily in a plane with some out of plane motions. Therefore the surface is represented as a single-valued function of x and y, where x and y are the coordinates in the plane. If the surface becomes non single-valued as it distorts (e.g. it wraps back upon itself) then Streams will not be able to represent this motion.

A suite of calculators, including user-defined calculators, is provided with both the 3D displacement fields and the 3D surface displacement fields.

A standard set of transformations, including linear transforms, axis swapping, extraction of a subset of the field, and incremental time-averaging, are also provided for each of the 3D displacement fields.

1.2 Three dimensional Lagrangian Fields

The support for 3D motion has been extended to 3D Lagrangian fields. These mimic their 2D counterparts in nearly everyway, except for the fact that all particle tracks are now in 3D space. A standard set of calculators is provided for 3D Lagrangian Fields as well as a Join Lagrangian Paths process.

1.3 Tablets

Tablets are proving to be a very useful addition to Streams, enabling rapid analysis of computed fields. A number of enhancements to Tablets are included in Streams 3.01. The primary changes are:

1. A significant number of new functions have been added to the function library. These can be found discussed in the Field Objects: User's Guide manual.
2. The user can now drag and multiple commands in the command line of the Tablet analysis view. This provides powerful support for processing similar datasets using the same sequence of commands – effectively an analysis script. These commands can be executed in parallel or in series relative to the rest of the application. Executing in parallel of course means the user can do other things while waiting for the script to execute, but it does have the limitation that new entities cannot be created and then used within the script as there is no guarantee that the new entity is known to the system when it is used. By executing the commands in series the order of operations in the script is ensured and new entities can be created and used as required.

1.4 Field views

Two new field views have been added to Streams 3.01.

1.4.1 Offset graph view for 2D scalar fields.

This view plots multiple profiles from the field on the same graph (similarly to the multi graph view), but these are now offset with respect to one another so that their ordering is more obvious. A range of options is available to the user to adjust how this view is rendered.

1.4.2 Animated surface view for 3D scalar fields.

This view provides an animated version of the surface view for scalar 2D fields. The additional dimension is assumed to be time and is used as the animating variable.

1.4.3 Overlays

A number of views now have support for overlays – in other words the ability to display more fields than just the field itself. For example scalar 1D field graph views have been able to superimpose multiple scalar 1D fields on the same graph for easy comparison, and scalar 2D field contour views could overlay 2D vector fields.

The following field views now support overlays:

- Scalar 2D field offset graph view supports overlays of other scalar 2D fields and also scalar 1D fields.

- Scalar 2D contour view supports the overlay of scalar 1D fields as well as 2D vector fields. These scalar 1D fields are assumed to be curves within the plane (i.e. y(x)).

- Scalar 2D surface views supports the overlay of scalar 2D fields. These scalar fields can be used to provide the colour map on the surface.

- Scalar 3D animated surface views supports the overlay of scalar 3D fields. These scalar fields can be used to provide the colour map on the surface.

- Vector 2D field 2D vector view supports the overlay of scalar 1D fields in the same way as the scalar 2D field contour view.

- Vector 2D field 2D particle track view now supports the overlay of scalar 1D fields in a similar way to its vector view.

Views with overlays can display legends. Often the text to be used for these legends is the same for a number of similar graphs. The user can now choose a particular set of legend labels as defaults and use them in other views of the same type.

Management of field views is always a problem with limited screen space. New options to facilitate easier view management have been added to Streams 3.01. Double clicking any field view will cause it to shrink to a quarter of the screen size in the bottom right hand corner of the main application window. Double clicking on it again will cause it to return to its original size. Toolbar buttons enable the user to shrink or expand all field views currently open and to cycle through them in either direction, thus bringing each view to the front in its turn.

1.5 Global menu shortcuts

Streams 3.01 now provides global menu keyboard shortcuts to the many of the menu options in the main application window. The shortcut key combinations are listed next to the menu item.

1.6 Drag and drop on particle record particle views

Streams 3.01 now provides a quick and easy way to combine particle records, either by overlaying them or concatenating them. This has been available via a free process, and this process still provides the greatest flexibility, but now particle records can simply be dragged onto the particle view of another particle record (of the same dimension) thus combining them.

1.7 Constructing fields from text files

While Streams has always had the capability to export field data to text file to facilitate data exchange with other applications it has not, until this point, allowed the import of text file data in order to create fields. Under the Field menu in the main application window the user can now create scalar 1D fields, scalar 2D fields, vector 2D fields 1D and vector 2D fields 2D from text files. See the manuals for information the format of these files.

1.8 Constructing particle records from text files

Similarly Streams now has the capability to create 2D and 3D particle records from text files. These options are available in the Particle menu of the main application window.

1.9 Calibration of 3D perspective cameras

The calibration of 3D perspective cameras, used in the 3D particle tracking subsystem, have some additional features. It is now possible for the user to exclude the lens distortion parameters from the optimisation process as well as the use of multi-media. For some experimental setups the distortion may be known to be negligible.

In order to explore the impact of noise in the 2D images or the 3D coordinates used by the camera for its calibration it is now possible to impose random noise on the particle locations in these images in order to understand the impact of that noise on the deduced camera

parameters.

1.10 *Generalised coordinate mapping transform for 2D particle records*

The mapping of pixel coordinates to physical coordinates has been supported through a number of mechanisms in Streams 3.0 and earlier. Firstly, the specification of the spatial scales in the image sequence from which particle record is generated, enables a simple mapping between pixels and physical coordinates. Secondly the barrel-pincushion transform enabled camera distortions to be removed from the pixel/physical coordinates. In Streams 3.01 a third, more general coordinate mapping transform (called map coordinates) is provided. In this case the user is able to provide formulae that map original coordinates to new transformed coordinates. Functionality has been built into Tablets that enable the user to derive third order polynomials in 2 dimensions for such a mapping although that is not a requirement. This new transformation provides a number of interesting opportunities. We have used it our structural laboratory when the camera capturing the particle motion is not viewing at right angles to the plane in which the particles are moving (perhaps due to experimental constraints).

1.11 New particle record views

Streams 3.0 provided a diagnostic view for particle 2D records and a comparison view for particle 3D records. The first of these compared the particle matches between two particle 2D records while the second compared the particles themselves between two particle 3D records. In Streams 3.01 a comparison view has been added to the list of views for a particle 2D record and a diagnostic view has been added to particle 3D records.

1.12 Expanded drag and drop support

Further support for drag and drop has been added to Streams (some examples have been mentioned above). In particular dragging from the Objects list view is now supported.

2. Bugs

As usual I need to make the disclaimer regarding bugs. My students and I have done significant testing but no doubt some bugs remain so any feedback on new bugs identified would be much appreciated.

A number of old bugs have been corrected in the new version.

In addition if you find errors in any of the manuals please let me know.

3. Manuals

With this release of the software the manuals have been updated and are available in PDF format with the download from the Streams website. All enhancements are documented in the manuals.