

Series Slots with Periodic Input

Design for RiverWare 6.3

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This document describes a new type of series slot in RiverWare which supports optional specification of input values for the series through a periodic-slot-like definition.

0.1 Document Status

07-31-2012: Ready for review.

0.2 Contents

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1.0 Functional Description

1.1 Overview

At times, users have wanted to specify inputs in the form of a periodic slot for entities which are implemented as series slots within RiverWare. This has come up for physical entities such as “Precipitation Rate” on reservoirs and for “policy” entities such as guide curves. In several instances, RiverWare engineering objects have been enhanced to switch between reading inputs from a series slot or a periodic slot based on a method selection. Similar mechanisms can be implemented in RPL for user-defined input slots on data objects.

For series slots which -- *by design* -- are intended to provide *inputs*, it would be simpler for users to have the ability to specify the values of such slots with a **periodic input definition**. The new **Series Slots with Periodic Input** optionally provide this capability -- but behave like ordinary series slots in virtually every other way.

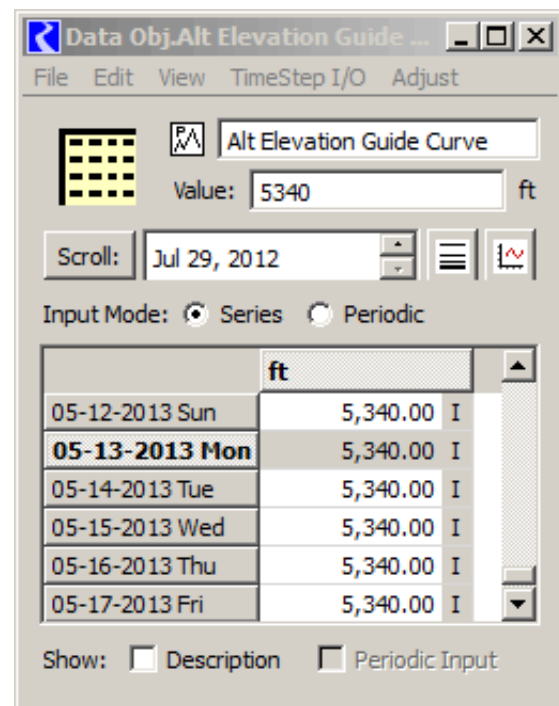
These new slots support two **Input Modes**:

- When in ordinary **Series Input Mode**, the individual time-series values of Series Slots with Periodic Input are directly editable by the user in the Open Slot Dialog and in an SCT. In this mode, these slots are functionally equivalent to ordinary series slots.
- When in **Periodic Input Mode**, only the periodic input definition is editable. As with actual periodic slots, the user has the choice of several standard periods (e.g. annual, monthly, daily), and either “irregular” or “regular” intervals within the period (e.g. *monthly intervals within an annual period*).

The following Series Slots with Periodic Input are now available:

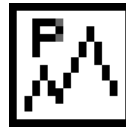
1. A set of existing engineering object series slots (including only those which only provide inputs to the model) have been converted to Series Slots with Periodic Input. These slots in existing models and on newly created objects start off in Series Input Mode. They can be switched to Periodic Input Mode by the user.
2. New Series Slots with Periodic Input can be created by the user on data objects. These also start off in Series Input Mode, and can be switched to Periodic Input Mode.

In general, when switching a Series Slot with Periodic Input from Series to Periodic Input Mode, the existing series values are lost; they are overwritten with values computed from the periodic input definition. However, when switching from Periodic to Series Input Mode, the periodic input definition becomes inactive, but is retained internally for possible future use.



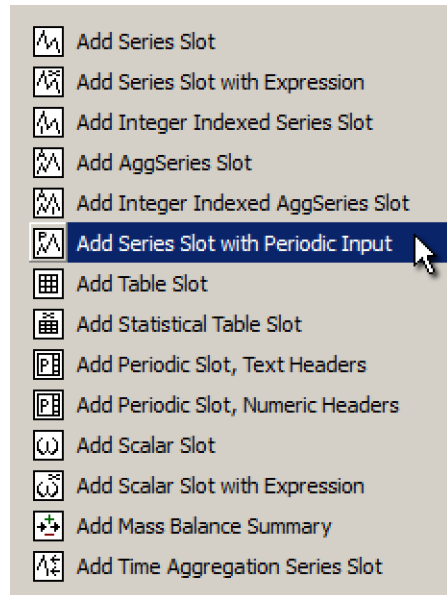
1.2 Slot Creation

Series Slots with Periodic Input are created automatically on engineering objects which support them for the representation of certain physical and “modeling” entities. They are generally dependent on a particular method selection of the object, and will appear as slot items in the Open Object Dialog with the illustrated “*P and series trace*” slot icon.



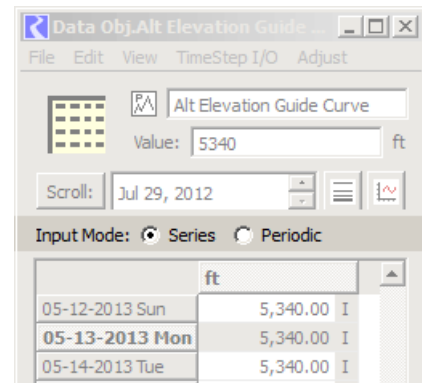
Series Slots with Periodic Input can also be created on data objects by the user. From the Open Object Dialog for a data object, under the “Slot” menu, select the “Add Series Slot with Periodic Input” item.

Operations which support the special features of Series Slots with Periodic Input are implemented in the Open Slot dialog.



1.3 Series Input Mode

Series Slots with Periodic Input start off in Series Input Mode, where they behave as ordinary series slots. (See the image in the Overview section). While they are intended strictly for “Inputs”, there is no implemented functionality which explicitly prevents these slots to be written to, e.g. from RPL.

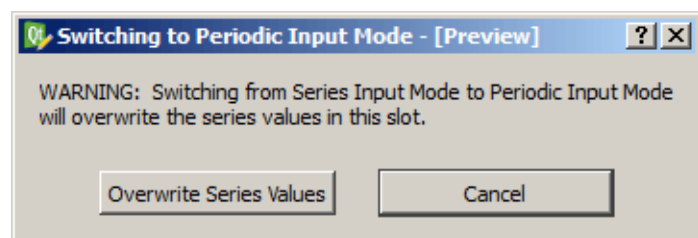


1.4 Switching between Series and Periodic Input Mode

The Series Slots with Periodic Input’s Open Slot Dialog shows two “Input Mode” radio buttons to indicate the current input mode and to switch to the other mode.

These radio buttons are disabled (inoperable) in RiverWare Viewer Mode and in a Scenario Baseline Model.

When switching from Series Input Mode to Periodic Input Mode, the series values are overwritten by values computed from the periodic input definition. If that definition is empty, or contains only NaNs, then the series will be cleared (all NaN). For this reason, the user must confirm this Input Mode change with this popup dialog.



This conformation query is not shown if the series data is empty (all NaN) or if the series data matches the series that would be computed from the current periodic input definition.

No confirmation dialog is shown when switching from Periodic Input Mode to Series Input Mode, as there is no loss of data in that change. The periodic input definition is made inactive, but is left intact for possible future use (i.e. if the user switches back to Periodic Input Mode).

Switching between these two modes never changes the series slot's configured time range. Series values are computed only for the series slot's currently configured time range. Of course, the series value computation from the periodic data always overwrites "Input" flagged timesteps in the series.

1.5 Periodic Input Mode

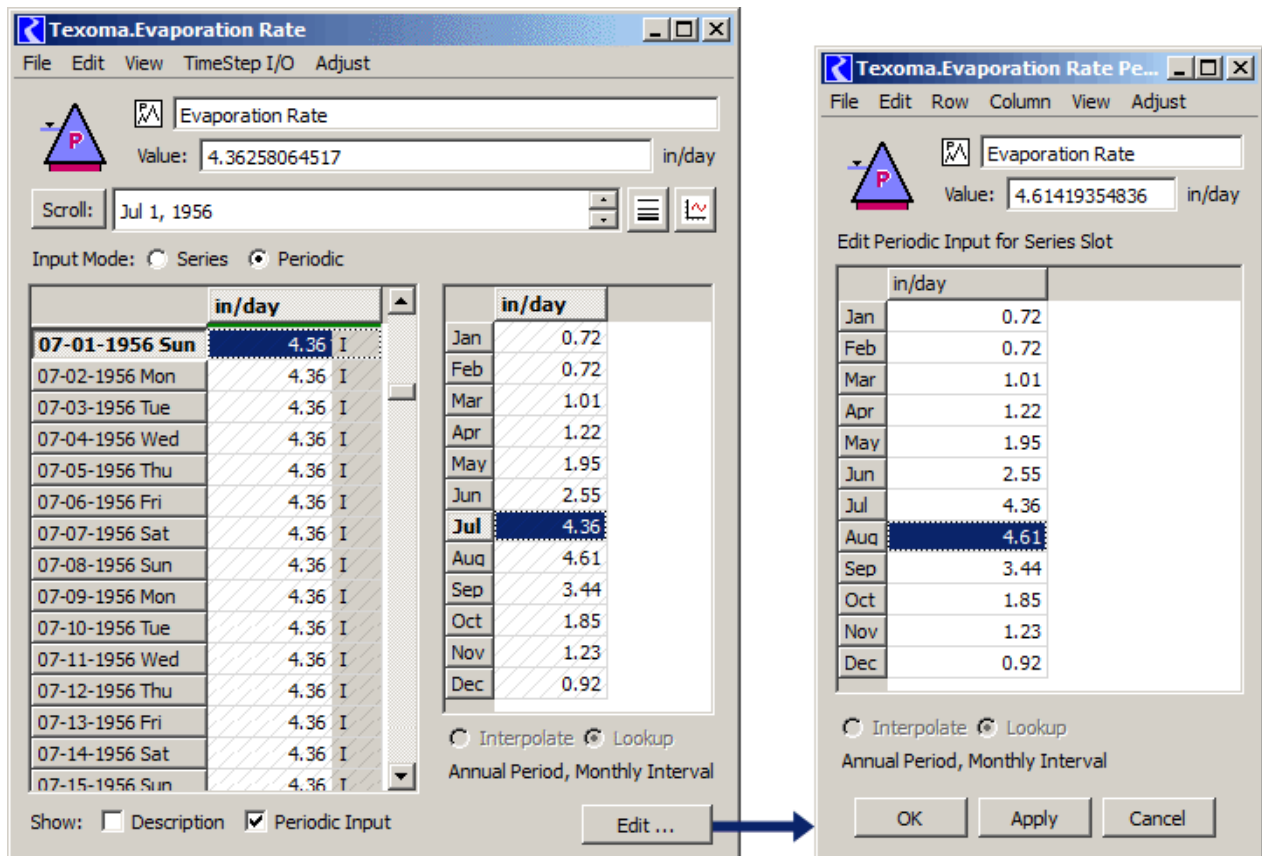
Series Slots with Periodic Input in Periodic Input Mode have "read-only" (non-editable) series data, indicated as cross-hatched in series data displays -- the Open Slot Dialog and the SCT. The Open Slot Dialog shows the series data, and optionally a read-only version of the periodic input definition data. The **periodic input definition panel** is shown to the right of the series data when the [Show:] "Periodic Input" checkbox is checked on.

The image shows two screenshots of the 'Texoma.Evaporation Rate' dialog box. Both screenshots show the 'Periodic' input mode selected. The left screenshot shows a table of daily data for 1956, with the value 4.36 in/day for the first row (07-01-1956 Sun). The right screenshot shows the same dialog with the 'Periodic Input' checkbox checked, displaying a monthly lookup table on the right.

Month	Value (in/day)
Jan	0.72
Feb	0.72
Mar	1.01
Apr	1.22
May	1.95
Jun	2.55
Jul	4.36
Aug	4.61
Sep	3.44
Oct	1.85
Nov	1.23
Dec	0.92

Note: the "Periodic Input" checkbox is enabled also in RiverWare Viewer mode and in Scenario Baseline models.

To edit the periodic data (and cause a recomputation of the slot's series data), the user must click the “**Edit ...**” button at the bottom of the periodic input definition panel. This button in the Open Slot Dialog is disabled in RiverWare Viewer mode and in Scenario Baseline models. Clicking the Edit button shows the “**Edit Periodic Input for Series Slot**” dialog *modally* -- the user must accept or cancel changes made in this dialog before being able to operate any other RiverWare dialog.



Although the Edit Periodic Input for Series Slot dialog is a modified presentation of the Open Slot Dialog for Periodic Slots, and although there is technically a hidden “Periodic Slot” within the implementation, the periodic input definition being shown is not supported as a “slot” in the RiverWare user interface. All slot-related actions in the menubar menus are disabled or hidden. The (periodic slot) configuration dialog IS available for configuring the periodic slot’s period and interval definition -- but “unit” and “display attribute” configuration settings are disabled; those attributes are inherited from the series slot. Column configuration is disabled; this periodic input definition is fixed at one column. Cell data editing operations are available, such as “Interpolate” and “Adjust Values”.

The **Apply** button causes the series slot values to be recomputed. If the periodic data is completely undefined, the series slot is cleared. TBD: Treatment of NaN values, with at least some other defined values. (If partial NaNs are not to be “interpolated over”, the “OK” and “Apply” buttons will be disabled -- unless all values are NaN).

The **OK** button performs the “Apply:” operation and dismisses the dialog.

The **Cancel button** will instead be shown as “Close” if there are no unapplied changes. When clicked, any unapplied changes (if any) are dropped, and the dialog is dismissed.

1.6 Persistence, I/O, Plotting and Model Report Generation

When saved in a RiverWare model file or exported via a “export object file”, all available series data and periodic data is retained (regardless of the currently active input mode). Of course, all new data used to support Series Slots with Periodic Input also persists (e.g. an indication of the active input mode).

The Model Report Generation feature in RiverWare recognizes Series Slots with Periodic Input in Periodic Input Mode as essentially Periodic Slots (except for the slot icon), and shows the periodic data for the slot.

To Be Reviewed: In the initial implementation of Series Slots with Periodic Input, *only series data* (not periodic data) DMI operations are supported. Furthermore, an error is generated if an Input DMI attempts to assign series data to a Series Slot with Periodic Input which is in Periodic Input mode.

To Be Reviewed: Series Slots with Periodic Input will be plotted as *series slots* (with a time range limited to the series slot’s configured time range).

2.0 Implementation

2.1 Data Model

Series Slot with Periodic Input is not a new C++ class. It is a SeriesSlot with additional properties, including:

- An internal flag distinguishing the SeriesSlot as being “with Periodic Input”.
- A dynamically allocated child instance of a Periodic Slot. The “parent/child” relationship implementation is modelled on the AggSeriesSlot’s maintenance of child SeriesSlots for its slot columns. A significant difference, however, is that the child Periodic Slot is completely “private” within the SeriesSlot, and is not exposed within the user interface as a slot.

The child Periodic Slot has a (private) name of “Periodic Input”, and is serialized with a “dot” (‘.’) prefix, similar to AggSeriesSlot columns.

The child Periodic Slot uses the display attribute settings (e.g. display units, and also unit type) of the parent SeriesSlot. As the child Periodic Slot is hidden from RiverWare (except within its parent SeriesSlot), propagation of those attributes to the child slot is a simple matter.

2.2 Special Function Development

- Computation of a Series Slot’s values (for its current timestep range) from a Periodic Slot. (Note: It’s OK to allow series-value-changed callback generation to occur on every series timestep assignment, as this operation generally occurs at “GUI” time, and anyway, that’s normal).
- Comparison of a Series Slot’s values (for its current timestep range) to values computed from a Periodic Slot. (This is a minor addition to the prior function).

2.3 DMI Issues

A small amount of special handling is required for DMI Import operations. (See section 1.6, above). In particular, checks for attempting to import series data into a Series Slot with Periodic Input which is in Periodic Import mode is needed.

2.4 Open Slot Dialog

The following features need to be supported by the SlotQtDlg class, and related classes:

- Implementation of “Input Mode” radio buttons, and support for mode switching, including user confirmation.
- Implementation of the [Show:] “Periodic Slot” “row-o-toggles” checkbox.
- Management of the Periodic Input Definition Panel, consisting primarily of a (Qt4) “SlotDataTableView” and “SlotDataTableModel” to display non-editable periodic data.
- Geometry Management Issues -- automatic panel width adjustments

2.5 Edit Periodic Input for Series Slot dialog

Additional enhancements to SlotQtDlg and related classes:

- Independent modal deployment of a SlotQtDlg
- Management of dialog subtitle text: “Edit Periodic Input for Series Slot”
- Management of the “OK / Apply / Cancel-Close” button panel and buttons; enabled states.
- “Apply” action: computation of the series slot values from periodic data.

2.6 Model Report Generation Support

The Model Report Generation feature in RiverWare recognizes Series Slots with Periodic Input in Periodic Input Mode as essentially Periodic Slots (except for the slot icon), and shows the periodic data for the slot.

2.7 Already Completed Tasks and Eliminated Tasks

These tasks were completed in the course of developing this design document.

- Prototype partial data-model support sufficient for creating these slots on data objects.
- (Data Object) Open Object Dialog hooks for creating these slots.
- Prototype slot icon design, QPixmap creation and implementation support.

Also, here is a quick mention of tasks which were part of prior development analysis, but which are no longer relevant.

- Concern for unit-propagation mechanisms became moot, as the exposure of the child Periodic Slot has been significantly restricted.
- It has been determined that protection against overwriting computed-series data (from various RiverWare features outside of the “Series Slot with Periodic Input” computations) can rely on “Input” flags, with the minor exception of Input DMI execution.
- No extension to the SeriesSlot’s time range in response to out-of-range reads (i.e. to emulate Periodic Slot functionality) is required. This isn’t a relevant feature.
- No enhancement to the “Find Input Slots” dialog is necessary. The “Input” flags on the Series Slot will cause that mechanism to find these slots.

3.0 Development Time Estimates

Estimate revision: 7-31-2012 (Phil)

Task	Est. Days	Description
2.1	3.0	Data Model, including serialization
2.2	0.5	Special Function Development
2.3	0.5	DMI Issues
2.4	2.5	Open Slot Dialog, new panel management, and geometry management issues.
2.5	2.5	Edit Periodic Input for Series Slot dialog
2.6	1.0	Model Report Generation Support
	1.0	Feature Documentation
	1.0	Post-Development Review Changes
	12.0	TOTAL [Days, estimated 7-31-2012]

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