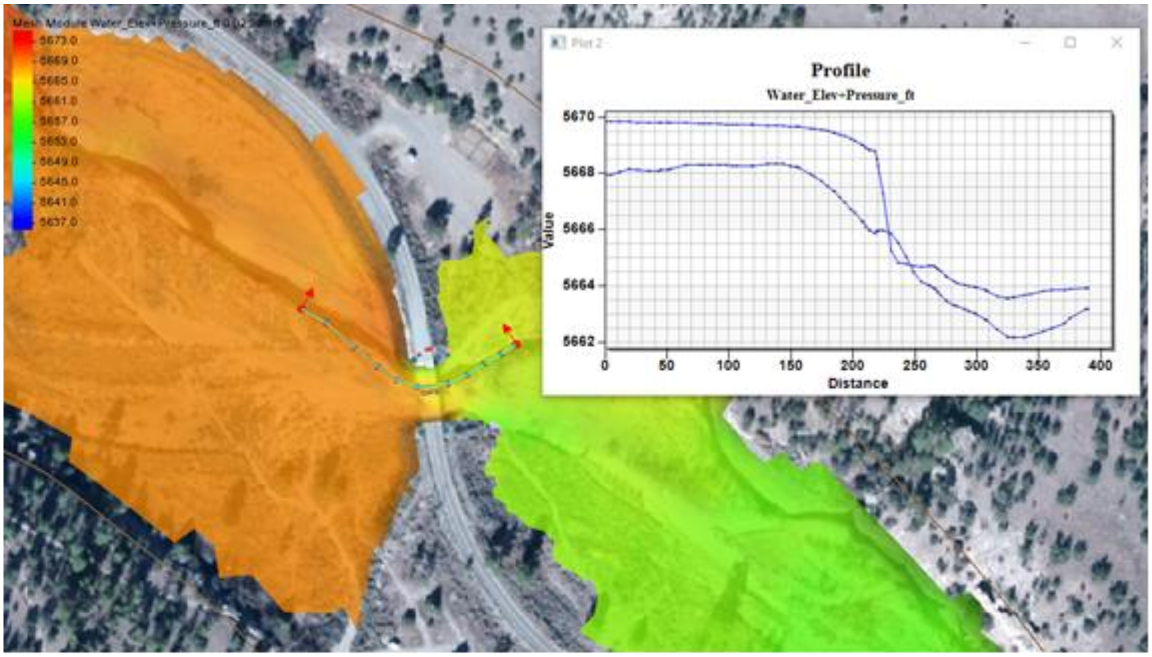
SMS 14.0

SMS 14.0 Tutorial

SRH-2D Advanced Simulation – Calibration

Calibration Tool for SRH-2D



Objectives

This tutorial demonstrates how to use the SRH-2D calibration feature.

Prerequisite Tutorials

- Overview
- SRH-2D

Required Components

- SMS Core
- SRH-2D Model & Interface

Time

- 10–20 minutes

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1 Introduction

This tutorial demonstrates how to use the calibration feature with SRH-2D in SMS. Calibration speeds up the process of finding the parameters necessary to create a simulation that properly converges. It does this by automating the process of estimating a large number of parameters.

This tutorial goes through two PEST iterations for demonstration purposes. Additional iterations can be completed if desired.

This tutorial makes use of an idealized river in order to demonstrate this feature.

2 Getting Started

Start by importing a project file containing an existing mesh:

1. Launch the SMS application.
2. Select *File* | **Open…** to bring up the *Open* dialog.
3. Select "Project Files (*.sms)" from the *Files of type* drop-down.
4. Browse to the *data files* folder for this tutorial and select "Gila_Calibration.sms".
5. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1. The project contains a 2D mesh, an SRH-2D materials coverage, an SRH-2D monitor coverage, and an SRH-2D boundary conditions coverage. There are also two SRH-2D simulations named " Structure Flow" and " Calibration Flow". The " Structure Flow" simulation is the initial SRH-2D model that was created using a pressure flow bridge. The " Calibration Flow" simulation will be used to calibrate the model.

Review the " Structure Flow" model solution by doing the following:

6. In the Project Explorer, scroll through the solution sets under the " Structure Flow" folder.
7. Scroll through the different time steps for each of the solution sets.
8. When done, select the " Water_Elev+Pressure_ft" dataset to make it active.

After calibrating the model, a new group of solution sets will be imported.

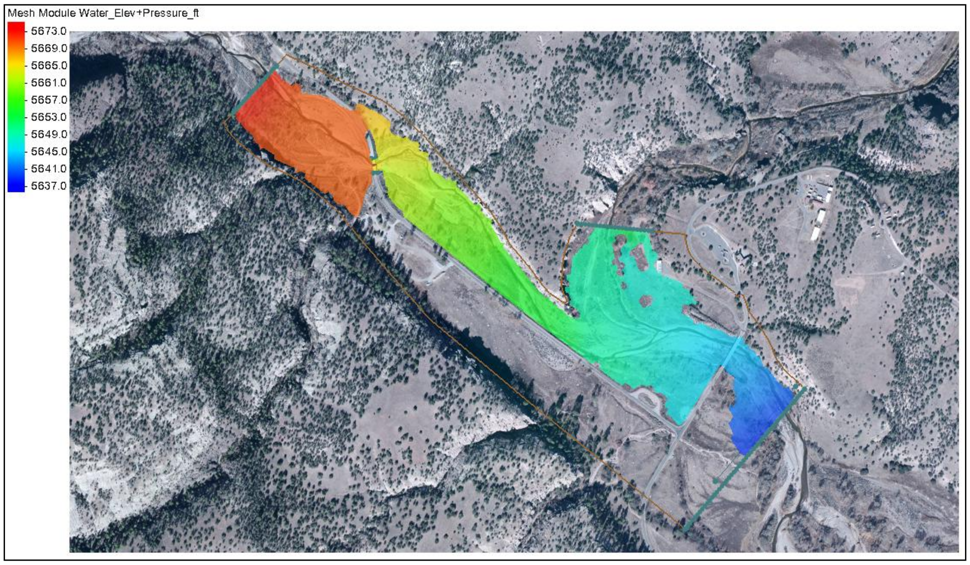

Figure 1 Initial project

3 Monitor Points

In order to calibrate the model, an observation point is needed. For SHR-2D, this point must be defined on the monitor coverage. For this example, do this by:

1. Select the " Monitor" coverage to make it active.
2. **Zoom** in on the area around the pressure bridge (Figure 2).
3. Using the **Create Feature Point** tool, create a point near the pressure bridge on the upstream side (Figure 2).
4. Using the **Select Feature Point** tool, double-click on the monitor point that was just created to open the *SRH2D Assign Monitor Point Properties* dialog.
5. Turn on *Measured value*.
6. For the *Water surface elevation* field, enter "5665.0".
7. Select **OK** to close the *SRH2D Assign Monitor Point Observation* dialog.

These water surface elevation values represent the values at the end of the SRH-2D run.

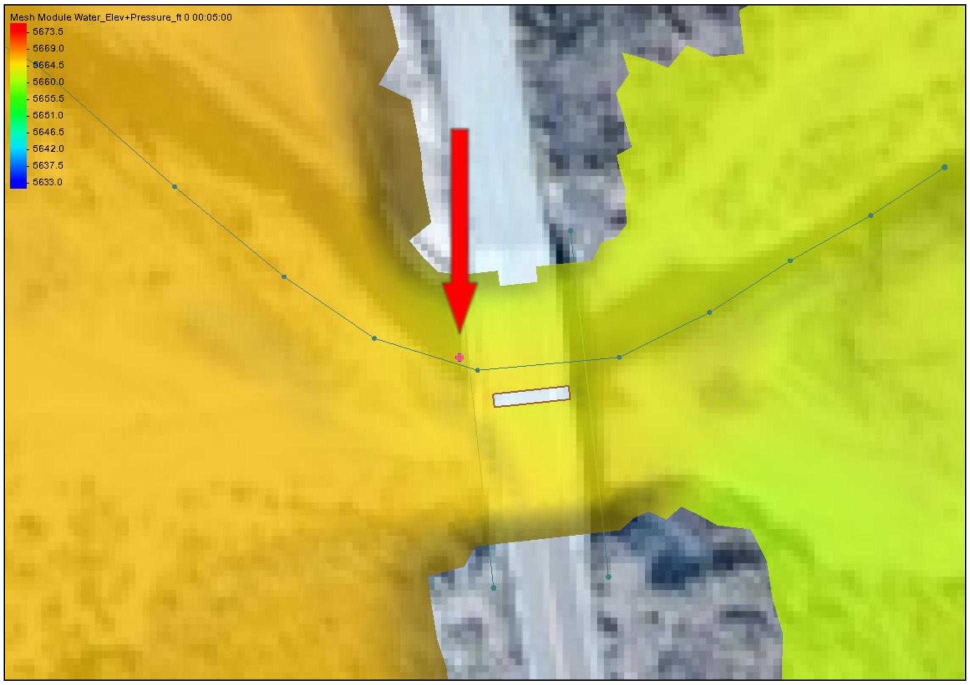

Figure 2 Observation point location

4 Calibration

The advanced simulation options allow using PEST to calibrate the model to the observed values at the observation point. SHR-2D will use PEST to run SHR-2D multiple times to calibrate the model to the specified parameters. The calibration parameters can be set to calibrate boundary conditions, material roughness, initial conditions, or number of time steps.

To activate the simulation calibration options, do the following:

1. Right-click on the " Calibration Flow" simulation and select *Tools* | **Advanced Simulation (Beta)…** to bring up the *Advanced Simulation* dialog.
2. Turn on the *Use parameters* option.
3. Change the *Run type* to be "Calibration".

The *Advanced Simulation* dialog allows setting the calibration parameters. After selecting the "Calibration" option, there are options to set the maximum number of iterations and the maximum number of iterations with no improvement. The maximum number of iterations determines the maximum number of optimization iterations that PEST is permitted to undertake on a particular parameter estimation run. The maximum number of iterations with no improvement will terminate execution of successive iterations if PEST has failed to lower the objective function.

For this example, the maximum number of iterations and maximum number of iterations with no improvement can be left at the default settings.

In this example, set the calibration parameters for the Manning's N parameters.

4. In the *Available parameters* section, check on the box in *Use* column for all the parameters with Manning's N listed as the *Type* column.
5. Leave all the entries under the *Value* column at their default settings.

6. For the *Min* and *Max* values, enter the following:

Description	Min	Max
Channel	0.015	0.09
Light Veg	0.025	0.1
Road	0.01	0.05
Trees	0.06	0.15
Dry Bed	0.02	0.1

7. Once done, click **OK** to close the *Advanced Simulation* dialog.

The calibration parameters have now been set.

5 Running SRH-2D

The model runs are now ready to be executed. Using PEST, multiple model runs will be started. To do this:

1. Right-click on the " Calibration Flow" simulation and select **Save Project, Simulation and Run** to bring up the *Simulation Run Queue* dialog.

All necessary input files for all of the model runs will be exported.

2. If advised of the monitor coverage being renumbered, click **Yes** to close the notice.
3. If a warning appears that the existing solution data will be removed from the project, click **OK**.

Note that the model run can take up to an hour or longer depending on computing process available. If desired, the model run can be skipped and the solution project file opened to see the result of the calibration run.

During the model run, the *Calibration Error* tab will show a plot of the simulation error vs iteration. The error is the sum squared weighted residuals. The units are length squared and multiplied by weight. There is a weight at each point, and it is computed by using the interval at the point. Points with a smaller interval will have larger weights compared to points with a larger interval. This mean PEST will work to match points with smaller intervals.

When finished, SRH will display a completion message in the *Command line* section of the *Simulation Run Queue* dialog for each of the model iterations.

4. Click **Load Solution** to import the solutions into SMS.
5. Click **Close** to exit the *Simulation Run Queue* dialog.

Solution sets from the calibration run will appear in the Project Explorer.

6 Viewing SRH-2D Output

Once the SRH-2D run completes, it will generate an XMDF file for the calibrated model run.

1. **Zoom** in on the area around the pressure bridge.
2. Select the “ Water_Elev+Pressure_ft” dataset under the “ Calibration Flow (SRH-2D)” folder and scroll through the time steps.
3. If desired, repeat the previous step for the “ Water_Elev+Pressure_ft” dataset under the “ Structure Flow (SRH-2D)”” folder and note the difference.
4. Continue viewing the remaining solution datasets.

Use the visualization tools in SMS as described in the “Data Visualization” tutorial or other tutorials to evaluate the solution datasets created by the SRH-2D model.

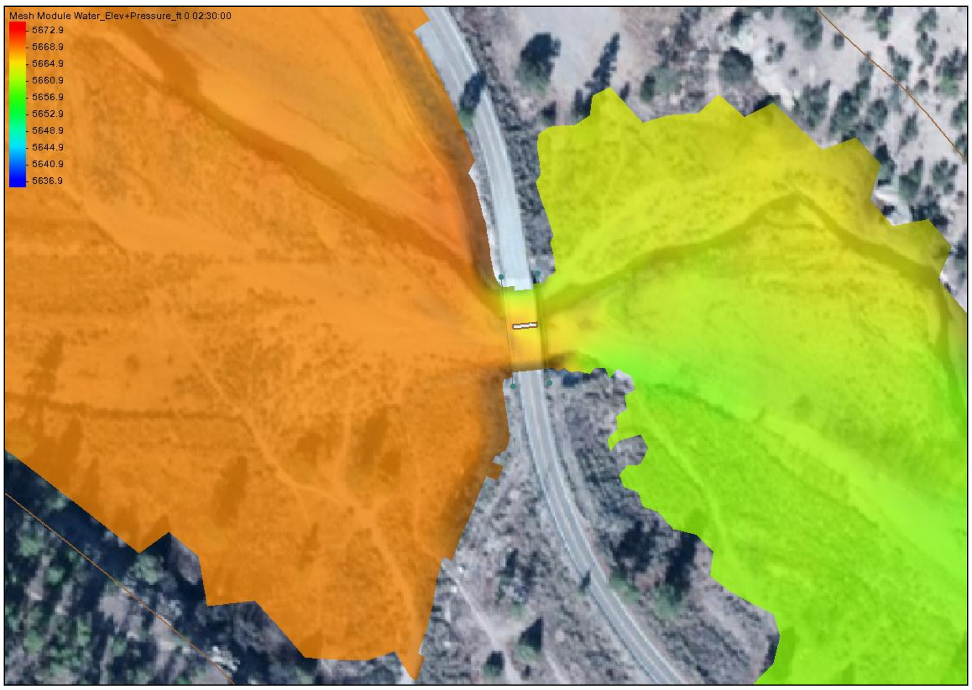

Figure 3 The calibration “Water_Elev+Pressure_ft” dataset on the last time step

7 Calibrating the Inlet

Additional options in the calibration tool can be explored, such as changing the inlet or outlet calibration parameters.

To add inlet calibration parameters, do the following:

1. Right-click on the “ Calibration Flow” simulation and select *Tools* | **Advanced Simulation (Beta)…** to bring up the *Advanced Simulation* dialog.
2. Change the *Show type* to “Inlet Q”.

Note that there are two listings for Inlet Q. This tutorial focuses on the Inlet Q listing with a *Value* of “900”. The other listing is to be left off and ignored.

3. In the *Available parameters* section, check on the box in *Use* column for Inlet Q listed as the *Type* column with a *Value* of “900”.
4. Leave the *Value* column at the default settings.

5. For the inlet *Min* and *Max* values, enter "800.0" for the Min and "1000.0" for the *Max*.
6. Once done, click **OK** to close the *Advanced Simulation* dialog.
7. Right-click on the " Calibration Flow" simulation and select **Save Project, Simulation and Run** to bring up the *Simulation Run Queue* dialog.
8. If a warning appears that the existing solution data will be removed from the project, click **OK**.
9. When the simulation is complete, click **Load Solution** to import the solutions into SMS.
10. Click **Close** to exit the *Simulation Run Queue* dialog.
11. **Zoom** in on the area around the pressure bridge.
12. Select the " Water_Elev+Pressure_ft" dataset under the " Calibration Flow" folder and scroll through the time steps.

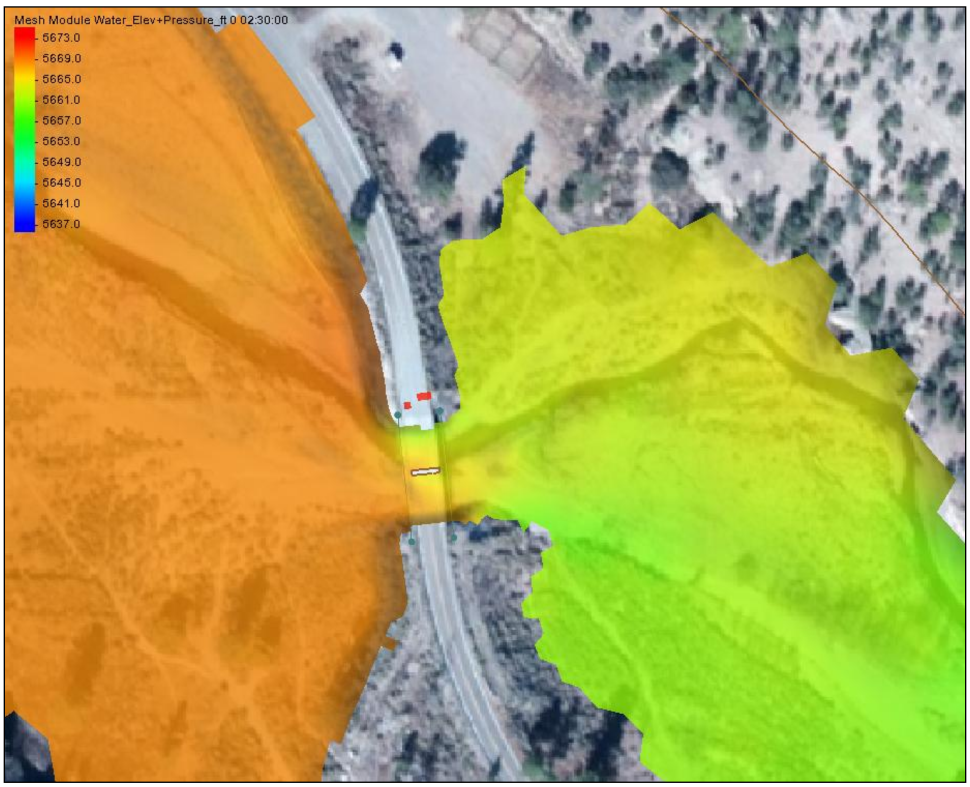

Figure 4 The calibration "Water_Elev+Pressure_ft" dataset on the last time step

This use of the calibration tool could be used to compute incipient overtopping of a bridge.

8 Conclusion

This concludes the "SRH-2D Calibration" tutorial. Feel free to continue to experiment with the SMS SRH-2D calibration tool, or exit the program.

