swift

3D Flooding Simulation Using SWIFT Multiphase Capabilities

Flooding is among natural hazards the most critical thread to mankind civilization all over the world. Material damages are significant and according to the UN, between 1963 and 1992 flood killed more people than any other natural disaster.

Today it is possible to predict flooding events using the SWIFT multiphase capabilities with a high degree of accuracy. The way in which a flood is distributed in a city or in the countryside, water height, velocity, pressure and forces are calculated at each location in 3D space and at each instant in time. Optionally sediment concentration, transportation and deposition can be calculated.

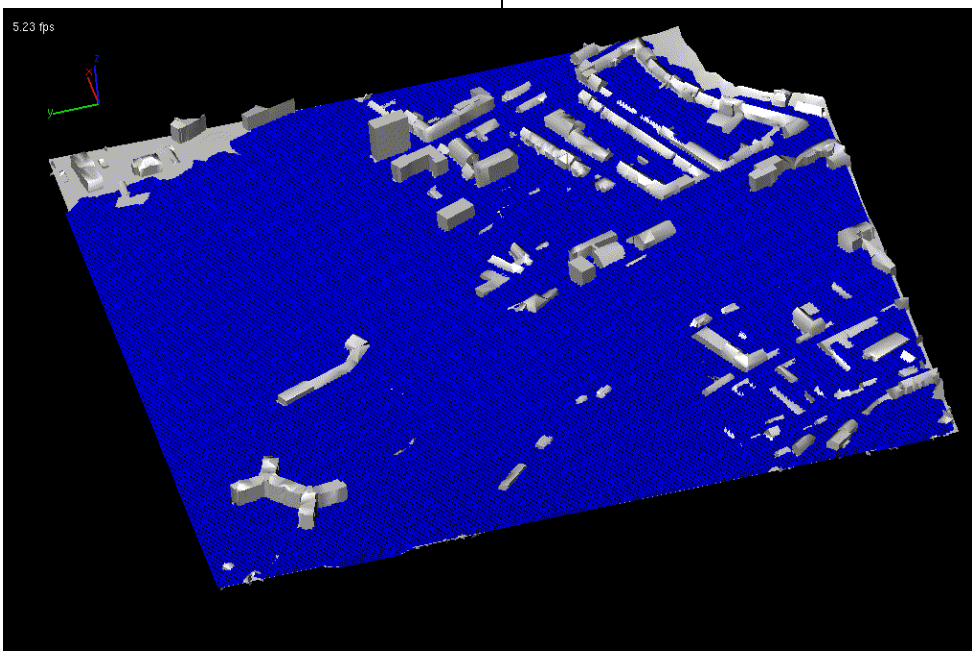
The methodology was developed in a cooperation between AVL and VRVis GmbH (Virtual Reality and Visualization).

The required input of topographic data and buildings is addressed by the methodology as basic requirements for the simulation as well as the special demands for the generation of computational meshes.

SWIFT's powerful multiphase capabilities are offering for each situation the suitable model: Homogeneous Multiphase, VOF (Volume of Fluid) , Multi- Fluid (Euler-Euler) and Euler-Lagrange Multiphase.

The simulation helps to identify endangered areas and supports the planning of protective measures, as well as showing the effectiveness of these measures. This new approach assists:

- Civil Engineering flood risk management
- Regulatory authorities assistance with flood warning, emergency planning and disaster relief
- Insurance industry more accurate base for the calculation of financial risks



It has to be mentioned that a dedicated version of SWIFT has already been successfully used to improve the protection of people, houses, road and railway tracks against another natural hazard: avalanches. The methodology development and validation program were performed in cooperation with the Department of Avalanche and Torrent Research of the Austrian government.

Case Study

A real city area is the subject of this flooding simulation study. A river that flows through center of the city, is used by several local power stations. The case of dam breaking in the upper part of the river and flooding of the center is simulated. The grid for the analyzed area was generated by using AVL FAME The analyzed domain is 800m x 800m and the height of the mesh is extended 11m above the riverbed.

The forcing condition is a discharge of 1100 m3/s, which applied suddenly by a flood wave that moves down the center of the city.

Figure 2 shows the degree of flooding in the different regions by volume fraction scaling. Red color shows 100% water and blue 100% air regions.

The high computational efficiency of the method has made it possible to provide fine details of the water cir-

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culation, velocity and pressure around the buildings in the city area during the flooding process. This simulation method enable the regulatory authorities to assess a flood zone warning even in the areas where no flooding histories are documented.

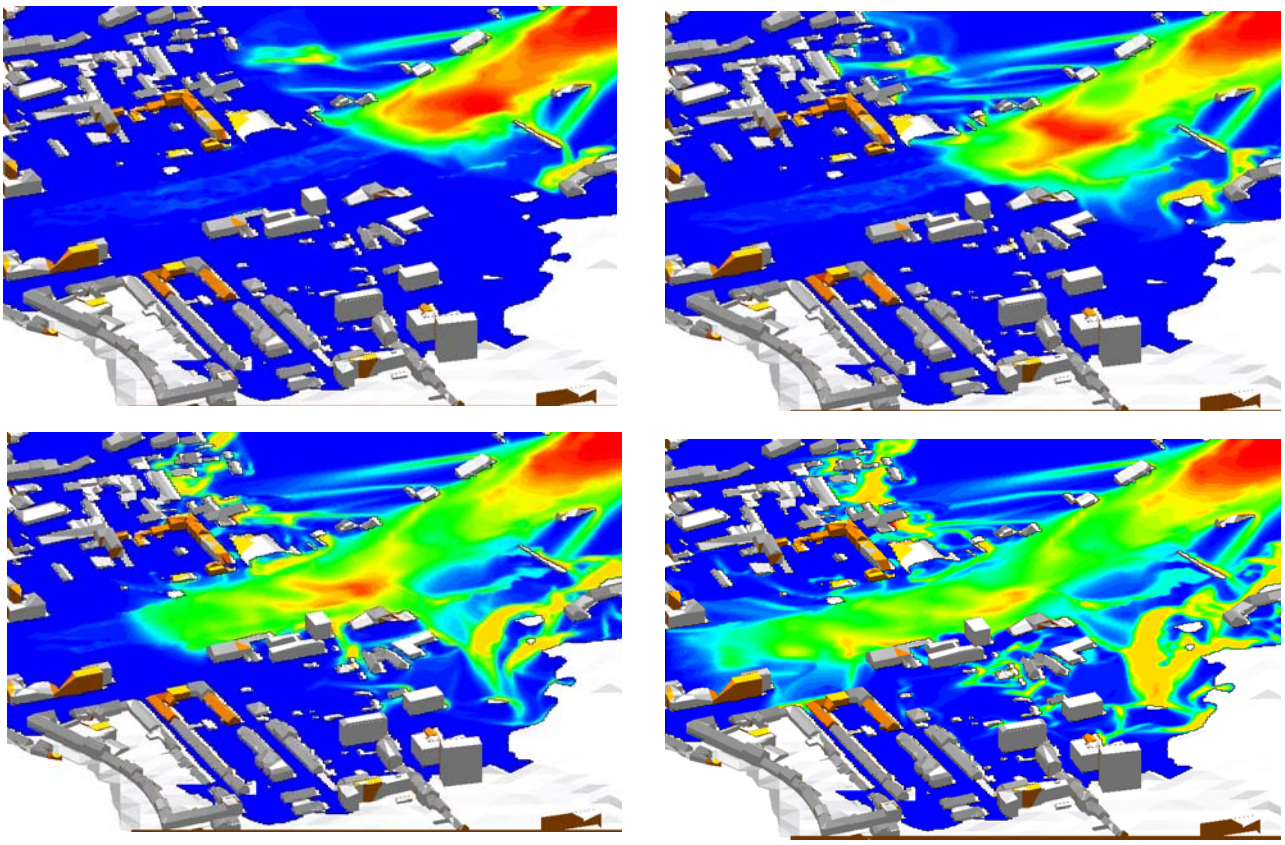

Figure 2: Computed volume fraction of the water during the flood phase

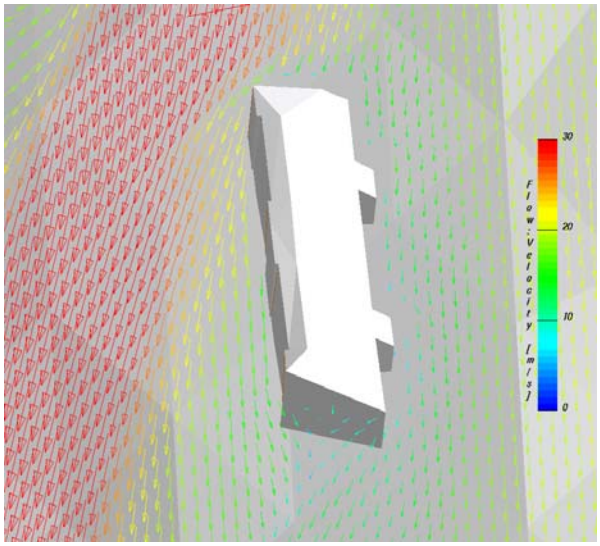

Figure 3: Details of the flow field

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