

# MixSim 2.0

MixSim 2.0 is a product designed to facilitate the analysis of stirred mixing vessels using Fluent Inc.'s Computational Fluid Dynamics (CFD) software technology. The program combines a fully-featured FLUENT 6.0 CFD solver with a special application-oriented user interface that allows for fast and easy preprocessing, solving, and postprocessing of mixing tank CFD analyses.

The complete mixer configuration is specified in an interactive user interface with immediate graphical feedback. MixSim then uses the professional preprocessing program GAMBIT 2 internally to automatically create the CAD geometry and mesh it in an appropriate manner for the intended type of analysis. At various steps, files in native GAMBIT and FLUENT formats are saved. Apart from using the FLUENT files inside MixSim, all of these files can be read by the stand-alone versions of the respective products for individual use. You can perform the calculation on the automatically-generated mesh with only a few mouse clicks. Extensive, easy-to-use postprocessing tools are available in the same user environment.

## Flexibility

MixSim 2.0 offers great flexibility to the beginner as well as the experienced user:

- In the geometrical definition of the mixing equipment under investigation, all parameters can be defined as functions based on other parameters, both of the same and of other objects.
- Additional geometrical objects (impellers, stationary tank internals, etc.) can be added to the range of MixSim's capabilities by adding new items to its library of so-called "MixSim object files." In each of these files, a particular object class is defined with all information necessary for MixSim to handle it appropriately in all stages of the CFD mixing analysis.

For experienced GAMBIT and FLUENT users, the following items are of interest:

- After the geometry and mesh have been generated by GAMBIT under the automatic control of MixSim, the user can load it in a stand-alone GAMBIT session and modify it as desired. This will generally not be necessary, but will allow the experienced user to investigate complex configurations based on the geometry and mesh created by MixSim.
- Similar to any automatically-generated mesh, the manually-modified mesh can be read into MixSim for the automatic model setup and solution. Before, during, or after the iterative numerical solution process, the user can use MixSim's built-in unrestricted FLUENT 6.0 GUI in order to investigate and modify the model setup. This will generally not be necessary, but it will allow users to perform any type of advanced analysis in a FLUENT 6.0 environment without having to leave the MixSim session.

## CAD Impeller Import

Arbitrary impellers can be imported by the way of a clean ACIS (.sat) CAD file. This file must be prepared using GAMBIT or another CAD tool that is capable of exporting ACIS (.sat) files in ASCII format.

## Features

Without any knowledge of GAMBIT and without interfering with the FLUENT GUI available in MixSim, you can make full use of the following features:

### *General Features*

Single-phase fluid flow CFD analysis of cylindrical mixing tanks with baffles, multiple shafts in fully arbitrary positioning and orientation, and one or more impellers on each shaft.

### *Tanks*

- Cylindrical, with any of the following top and bottom shapes:
  - ◆ Flat
  - ◆ ASME dish (6% torispherical head)
  - ◆ ASME dish (10% torispherical head)
  - ◆ Ellipsoidal
  - ◆ Conical
  - ◆ Curved (cap of a sphere)
  - ◆ Spherical
  - ◆ Klöpperboden
  - ◆ Korbboogen
- Tanks that are not completely filled are assumed to be standing upright
- In partially filled tanks, only the liquid-filled part of the tank inner volume will be meshed. The free liquid surface will be approximated by a “symmetry” type boundary condition.

### *Baffles*

- Allocated in one or more sets of one or more baffles that are spaced at equal angular intervals around the tank; variable start angle
- Baffle types:
  - ◆ Flat
  - ◆ Oval
  - ◆ Round
  - ◆ “Profile” - defined by point coordinates in the MixSim object file

### *Shafts*

- Entering through tank top, bottom, or side
- Arbitrary mounting position and angle in all possible degrees of freedom

### *Impellers*

- Generic impellers:
  - ◆ Simple helical impeller
  - ◆ Simplified “high efficiency” impeller
  - ◆ Simplified “interference” impeller
  - ◆ Pitched blade impeller (with twisted or conical blades)
  - ◆ Radial impeller (with hub, disk, or both)
  - ◆ Retreat curve impeller
  - ◆ Generic Smith type impeller

# MixSim 2.0

- “Named” impeller designs from literature:
  - ◆ Rushton disc turbine
- Proprietary impellers:
  - ◆ Various definition files for impellers of the following manufacturers are available:
    - ▲ Chemineer
    - ▲ Lightnin
    - ▲ Philadelphia Mixers

As some of these files contain confidential information, those are provided on request after permission has been granted by the impeller vendor.

## *Other Tank Internals*

- Straight draft tube
- Sparger ring (represented as a toroidal flow obstruction)
- Helical coil (represented as a helical flow obstruction with circular cross section - a representation of a helical coil through a “porous media” zone is available through the FLUENT 6 graphical user interface in MixSim)

## *Inlets and Outlets*

- At arbitrary locations

## *Single Phase Flow Correlations*

- Prior to CFD preprocessing, model setup, solving, and postprocessing, a selection of single-phase flow-related correlations can be calculated that allow you to predict shaft torque, mechanical power input, and 99% blend time.

## General CFD Modeling Approach

- MixSim 2.0 will always resolve the complete geometry of all tank internals.
- The automatic mesh generation and model setup will prepare and employ either of the following two approaches, depending on your choice:
  - ◆ “multiple reference frames” pseudo-steady-state solution
  - ◆ “sliding meshes” fully transient solution

## Fully-Automated Mesh Generation

- Without any further user interaction, MixSim will automatically create an unstructured (tetrahedral) mesh for the complete domain. It will choose appropriate local mesh spacings for the surface meshes on different tank internals. It will use various size functions to ensure good mesh quality and exact geometric representation of all geometric details while keeping the cell count low.
- In the large open voids in the tank, hex mesh regions can be positioned interactively, with graphical feedback to the user, during the model setup phase (before geometry and mesh creation). These will be meshed with high quality hex meshes that are then embedded in the automatically-generated unstructured (tetrahedral) mesh.

## Fluid/Flow Properties

- Constant density
- Constant or non-newtonian viscosity
- All turbulence models as available in FLUENT 6.0

## Graphical Postprocessing

- Grid display (available immediately after mesh generation and import)
- Contour plots
- Velocity vector plots
- “Sweep surface” functionality

## Alphanumeric Postprocessing

- Model setup (object parameters) report (with thumbnail picture of the geometry) in an HTML page
- NON-CFD correlations panel
- Automatic calculation of shaft/impeller torque and mechanical power input from the CFD results

## Other Postprocessing Tools

- Automatic creation of surfaces encapsulating each impeller
- Custom field functions
- Simple automatic generation of iso-surfaces for quick data investigation

## Online Help and Documentation

- User’s Guide, including Reference Guide, in hypertext (HTML) & Adobe Acrobat (PDF) file formats
- Context-sensitive online help with direct reference to hypertext online version of User’s/Reference Guide
- Online access to the User Services Center
- Tutorial Guide available online in the User Services Center
- Printed installation instructions
- Printed Getting Started Guide

## Supported Hardware

- MixSim 2.0 is provided for Intel-PC (Pentium family and compatible processor) systems running:
  - ♦ Windows (2000 or XP)
  - ♦ Linux (recent versions of SuSE or Red Hat distributions)
- FLUENT 6 and GAMBIT 2 files generated by MixSim are compatible to stand-alone versions of those products across all platforms that are supported by them.