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## Im2mesh (2D image to finite element mesh)

**Im2mesh** is an open-source MATLAB/Octave package for generating finite element mesh based on 2D segmented multi-phase image. It provides a robust workflow capable of processing various input images, such as microstructure images of engineering materials. Due to its generalized framework, Im2mesh can handle segmented image with more than 10 phases. Im2mesh was originally released on [MathWorks File Exchange](#) in 2019.

Im2mesh can also be used as a mesh generation interface for MATLAB 2D multi-part geometry.

**News:**

- Version 2.33 can refine mesh locally (see demo17).
- Version 2.2.1 can edit polygonal boundary before mesh generation.
- Version 2.2.0 supports using Gmsh as mesh generator (unstructured quadrilateral mesh).
- Version 2.1.6 updates the DOI. Im2mesh is now citable.

**Features:**

- Accurately preserve the contact details between different phases.
- Incorporates polyline smoothing and simplification
- Able to avoid sharp corners when simplifying polylines.
- Support phase selection before meshing.
- 4 mesh generators are available for selection: [MESH2D](#), [generateMesh](#), [Gmsh](#), and pixelMesh.
- Generated mesh can be exported as `inp` file (Abaqus), `bdf` file (Nastran bulk data, compatible with COMSOL), `msh` file (Gmsh mesh format), and MATLAB PDE model object.
- Mesh can also be exported as many other formats via Gmsh, such as `stl` and `vtk`.
- Graphical user interface (GUI) version is available as a MATLAB app.

## Dependencies

- When using Im2mesh package or Im2mesh\_GUI in MATLAB, you need to install MATLAB and the following MATLAB toolboxes: Image Processing Toolbox, Mapping Toolbox.
- When using Im2mesh\_GUI as a standalone desktop application, there is no need to install MATLAB or any MATLAB toolboxes. You can download the installer for standalone desktop app from: [link](#)

## Version compatibility

- Im2mesh\_GUI: MATLAB R2017b or later; version higher than R2018b is preferred.
- Im2mesh package: MATLAB R2017b or later. GNU Octave 9.3.0 or later.
- Gmsh: tested with version 4.13.1.

## How to start

After downloading Im2mesh package ([releases](#)), I suggest you start with [Im2mesh\\_GUI app](#) in the folder, which will help you understand the workflow and parameters of Im2mesh. A detailed tutorial is provided in [Im2mesh\\_GUI Tutorial.pdf](#).

Then, you can learn to use Im2mesh package in the folder "Im2mesh\_Matlab" or "Im2mesh\_Octave". 16 examples are provided.

- If you're using MATLAB, examples are live script `m` files ( `demo01.m` ~ `demo16.m` ). If you find some text in the `m` file is missing, please read the `html` file instead. Note that `demo02.m` requires MATLAB Partial Differential Equation (PDE) Toolbox. If you don't have PDE Toolbox, you can skip `demo02.m`.
- If you're using Octave, examples are `m` files ( `demo01.m` ~ `demo10.m` ).
- Examples are also available as `html` files in the folder "demo\_html".

**Examples:**

- [demo01](#) - Demonstrate function `im2mesh`, which use `MESH2D` as mesh generator.

- [demo02](#) - Demonstrate function `im2meshBuiltIn`, which use MATLAB built-in function `generateMesh` as mesh generator.
- [demo03](#) - Export: save mesh as `inp`, `bdf`, and `msh` file; save geometry as `geo` file or PSLG data.
- [demo04](#) - What is inside `im2mesh`
- [demo05](#) - Avoid sharp corner
- [demo06](#) - Thresholds in polyline smoothing
- [demo07](#) - Parameter `grad_limit` in mesh generation
- [demo08](#) - Parameter `hmax` in mesh generation
- [demo09](#) - How to select phases for meshing
- [demo10](#) - Different polyline smoothing techniques
- [demo11](#) - Find node sets at the interface and boundary
- [demo12](#) - Demonstrate function `pixelMesh` (pixel-based quadrilateral mesh)
- [demo13](#) - How to use `Gmsh` as mesh generator
- [demo14](#) - Use `polyshape` to define geometry for mesh generation
- [demo15](#) - Edit polygonal boundaries before meshing
- [demo16](#) - Add mesh seeds/nodes
- [demo17](#) - Refine mesh

## Cite as

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If you use Im2mesh, please cite it as follows.

Ma, Jiexian, & Li, Yuanyuan (2025). Im2mesh: A MATLAB/Octave package for generating finite element mesh based on 2D multi-phase image (2.1.5). Zenodo. <https://doi.org/10.5281/zenodo.14847059>

Once my paper is published, I will update a new DOI here.

## Acknowledgments

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Many thanks to Dr. Yang Lu for providing valuable suggestions and testing of export formats.

This project incorporates code from the following open-source projects. I appreciate the contributions of the original authors. Each incorporated code retains its original copyright.

- [MESH2D](#) by Darren Engwirda
- [dpsimplify](#) by Wolfgang Schwanghart
- [p\\_poly\\_dist](#) by Michael Yoshpe
- [MeshQualityQuads](#) by Allan Peter Engsig-Karup
- [ccma](#) by UniBwTAS

## Other related projects

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- [voxelMesh \(voxel-based finite element mesh\)](#)
- [writeMesh \(write mesh to inp, bdf, and msh files\)](#)