**Human-Informed Topology Optimization 2.0 (HiTop 2.0)**

HiTop is a human in the loop design optimization code first published in the paper "Human Informed Topology Optimization: Interactive Application of Feature Size Controls" (Ha, D. and Carstensen, J.V., 2023, Structural and Multidisciplinary Optimization 66:59. DOI 10.1007/s00158-023-03512-0).

HiTop 2.0 builds upon the original version of HiTop in the recent paper:

Gillian Schiffer, Dat Quoc Ha & Josephine V. Carstensen (2023) HiTop 2.0: combining topology optimisation with multiple feature size controls and human preferences, Virtual and Physical Prototyping, 18:1, DOI: 10.1080/17452759.2023.2268603.

Different from the original HiTop, HiTop 2.0 implements a GUI that allows for a flexible design problem formulation. Additionally, the user can make 1 or 2 changes to the minimum solid, minimum void, maximum solid, and/or passive regions of interest in the design.

**File Familiarization:**

To start, users should download the HiTop2\_0 folder. Enter the folder and you will find three files.

1. Parameters.m – this is where the user specifies the parameters below. The user will also find the authors’ general guidelines on what range for the parameters they have found to work best.

|  |  |  |  |
| --- | --- | --- | --- |
| Nelx | Number of elements in the x-direction | Nely | Number of elements in the y-direction |
| Volfrac | Volume fraction for optimization problem | rminS | Radius of minimum solid feature size |
| rminV | Radius of minimum void feature size | betaMMA | beta value for the Heavisides projection |
| betaHP | Same as betaMMA | Penal | Penalization factor for the SIMP method |

1. hiTopDriver.m – this is the driver file to run the HiTop 2.0 program.
2. addpath folder – this folder contains the supporting MATLAB scripts and MMA folder

**How it works (with L-Bracket example):**

1. Enter the appropriate variables for your design problem in the parameters.m file
2. Run the HiTopDriver.m MATLAB script
3. Highlight location of force
   1. The authors recommend zooming into the mesh to ensure accurate selection.
   2. For best results, only select <10 nodes and ensure the node locations are fully enclosed by your drawn rectangle Region of Interest (ROI)

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Proper selection of 8 nodes for the Too many nodes selected for load

L-Bracket Problem

* 1. Double click the ROI

1. Specify the direction of the negative force with 1 = x, 2 = y, 3 = x and y
   1. Assumed positive x and y directions below
   2. For L-Bracket, enter 2
   3. A black arrows pointing to a white background

      Description automatically generated with medium confidence
2. Enter whether you are going to emplace 1 or 2 boundary conditions
   1. For L-Bracket enter 1
3. Enter whether you want to manually draw (1) or automatically pick an edge (2) of the design domain for your boundary condition
   1. For L-Bracket enter 1
4. High the location of the boundary condition
   1. Ensure your ROI only encloses the desired nodes

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Proper selection of single Too many nodes selected No nodes are selected

line of nodes on upper

edge of domain

* 1. Double click the ROI

1. Specify the direction of the translation restriction with 1 = x, 2 = y, 3 = x and y
   1. For L-Bracket, enter 3
2. Enter whether you’d like to specify a solid (1), void (0), or no (0) passive region in the design problem
   1. For L-Bracket enter 0
3. Draw the passive region
   1. The authors find that drawing the passive region zoomed out, then zooming in to refine is a successful method to specify the passive ROI

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* 1. Next, zoom into the areas of the passive ROI that may overlap with force or boundary condition ROIs

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For the L-Bracket problem, the Proper selection of nodes Passive ROI overlaps location

passive region should be flush for the passive ROI of force nodes

to the force ROI

1. 50 Iterations will run automatically
   1. For the L-Bracket, the 50 iteration output will look like the the figures below, where a stress plot is presented to the user

A black and white image of a human foot

Description automatically generated A close-up of a dna helix

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1. Enter whether you want to make 1 or 2 changes
   1. For this example, the user will make 2 changes
2. Enter whether you want to specify a new passive ROI (3), max solid ROI (2), min solid (1), or min void (0)?
   1. For this example, the user will specify a passive void region (3) at the sharp corner in order to reduce the stress concentration.
3. Draw the 1st change ROI
   1. For the L-Bracket example:

A computer generated image of a wheel

Description automatically generated

1. Enter which phase you’d like to specify as passive (1) for solid, (0) for void
2. 50 Iterations run automatically
   1. If the user decided to only make one change, then the algorithm would run to 2000 iterations or convergence
3. Enter whether you want to specify a new passive ROI (3), max solid ROI (2), min solid (1), or min void (0)?
   1. For this example, the user’s second change will specify a minimum solid length scale in the thin lower, right portion of the L-Bracket.
4. Highlight the ROI on the stress plot.
   1. The authors have found success when singular members are identified, rather than middle of members.

A computer generated image of a dna

Description automatically generated

1. Enter contour lines, lambda (degree of gradation), and new radius
   1. For this example, the user set contour = 2, radius = 4, and lambda = 5
2. Run until convergence.

A black and white image of a dna helix

Description automatically generated

Final output