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| --- | --- | --- | --- | --- | --- | --- |
| Name (version) | **Availability** | **Optimization Type: Approach** | **Objective Functions (TO)** | **Constraints (TO)** | **Results (TO)** | **Link** |
| Abaqus + Isight (2020) (Tosca) | Commercial/Available at student edition | **Size**: NP (MMA), P (Isight)  **Shape:** NP (homogenization), P (Isight), Topography (optimal bead layout to improve bending stiffness or vibration)  **Topology:** TO (SIMP, RAMP, MMA) | Strain energy, volume, weight, displacement, rotation, frequency, reaction force, reaction Moment, internal force, internal moment, center of gravity, moment of Inertia | **Design**: dimensions, volume, weight, center of gravity, moment of Inertia  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  , frequency, reaction force, reaction moment, internal force, internal moment, rotation  **Manufacturing**: preserved region, member size, symmetry (planar, rotational, cyclic, point), mold (pull direction) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | <https://www.3ds.com/products-services/simulia/products/abaqus/> |
| Autodesk Fusion 360 (2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** NP (homogenization)  **Topology:** Generative Design | Mass, stiffness | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, safety factor  **Manufacturing**: preserved region, member size, symmetry (planar), cost, 3D printing orientation, overhang (angle), milling (direction, tool diameter, head diameter), 2-axis cutting, casting (pull direction) | **Optimized design**: faceted geometry **Plots**: load path, stresses, displacements | <https://www.autodesk.com/products/fusion-360/overview> |
| Autodesk Inventor (2020) | Commercial/Available at student edition | **Size**: P (Parametric Studies)  **Shape:** P, NP (homogenization)  **Topology:** N/A | Mass, stiffness | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.autodesk.com/products/inventor/overview> |
| Autodesk Netfabb (2020 | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP), Lattice (member modeling) | Compliance | **Design**: dimensions, lattices (size, type, strut thickness, orientation)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, 3D printing orientation | **Optimized design**: faceted geometry **Plots**: stresses, displacements | <https://www.autodesk.com/products/netfabb/overview> |
| Siemens NX (2020) | Commercial/Available at student edition | **Size**: P  **Shape:** P,NP (homogenization)  **Topology:** Generative Design , TO (SIMP, RAMP), Lattice (unifrorm) | Strain energy, volume, node displacement, eigenfrequency | **Design**: dimensions, lattices (size, type, orientation)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, casting (design area, pull direction, draft angle, mid-plane), symmetry (planar, cyclic) | **Optimized design**: faceted geometry **Plots**: stresses, displacements | <https://www.plm.automation.siemens.com/global/en/products/nx/> |
| Ansys Mechanical (Ansys, 2020) | Commercial/Available at student edition | **Size**: P  **Shape:** P, NP (homogenization  **Topology:** TO (OC, SIMP, Level set), Lattice (homogenization) | Compliance, mass, volume | **Design**: dimensions, volume, mass, stress, center of gravity, moment of Inertia, lattices (size, type, strut thickness, density)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, reaction force  **Manufacturing**: preserved region, member size, mold (pull direction), extrusion, symmetry (planar, cyclic), overhang (angle) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.ansys.com/> |
| Ansys Discovery (Ansys, 2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP), Generative design | Stiffness, natural frequency | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, mold (pull direction) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements, live update of results | <https://www.ansys.com/products/3d-design/ansys-discovery> |
| Solidworks (2020) | Commercial/Available at student edition | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Mass, stiffness, displacement | **Design**: dimensions, **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, mold (pull direction), symmetry (planar) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | <https://www.solidworks.com/> |
| Altair Optistruct (Altair, 2020) | Commercial/Available at student edition | **Size**: P, Topometry  **Shape:** P, NP, Topography  **Topology:** TO (OC, SIMP), lattice (member modeling) | mass, volume, weight, compliance, stress, strain, force, pressure, displacement, moment of inertia, frequency, center of gravity, buckling load factor, fatigue | **Design**: dimensions, volume, mass, weight, center of gravity, moment of Inertia, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  , frequency, reaction force, stress, strain, buckling load factor, fatigue  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic, pattern), pull direction, extrusion | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | <https://www.altair.com/optistruct/> |
| COMSOL | Commercial/Available at student edition | **Size**: P,  **Shape:** P, NP,  **Topology:** TO (SIMP, RAMP), Level Set, MMA, Lattices | mass, volume, weight, compliance, stress, strain, force, pressure, displacement, moment of inertia, frequency, center of gravity, buckling load factor | **Design**: dimensions, volume, mass, weight, center of gravity, moment of Inertia, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  , frequency, reaction force, stress, strain, buckling load factor  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic, pattern) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | https://www.comsol.com/ |
| nTopology (2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP), lattice (homogenization) | Compliance, volume, displacement, stress | **Design**: dimensions, volume, lattices (size, type, strut thickness, density, fillet radius)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, stress  **Manufacturing**: preserved region, member size, symmetry (planar), extrusion | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://support.ntopology.com/hc/en-us> |
| CATIA (2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** NP  **Topology:** TO (SIMP), Generative Design, lattice (uniform) | Stiffness, frequency, mass | **Design**: dimensions, center of gravity, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, reaction force, frequency, stress  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic), casting, overhang | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.3ds.com/products-services/catia/> |
| PERMAS (2020) | Commercial/Available at student edition | **Size**: P  **Shape:** P, NP  **Topology:** TO (SIMP) | Strain energy, volume, weight, displacement, eigenfrequency | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar, axial, cyclic, pattern), | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | <https://www.intes.de/kategorie_permas/einfuehrung> |
| CATOPO (2020) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Strain energy, volume | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar, axial, cyclic, pattern), casting | **Optimized design**: faceted geometry **Plots**: stresses, displacements | <http://ces-eckard.de/> |
| Eyeshot (2020) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Compliance, volume | **Design**: dimensions, volume, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.devdept.com/eyeshot> |
| FELyX (2006) | Open source | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Compliance, volume | **Design**: dimensions, volume, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface  **Plots**: N/A | <http://felyx.sourceforge.net/idea.html> |
| Simcenter Nastran/Femap (2020) | Commercial | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Compliance, weight, volume, natural frequency, buckling modes, displacement, strain, stress, reaction force, velocity, acceleration, acoustic pressure, eigenfrequency | **Design**: dimensions, volume, weight  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, frequency, velocity, acceleration, buckling modes, stress, strain, reaction force, acoustic pressure  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic), casting (pull direction), extrusion, overhang (angle) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.plm.automation.siemens.com/global/en/products/simcenter/femap.html> |
| BOSS Quattro (LMS Samtech, 2006) | Open source | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.swmath.org/software/11037> |
| FEMTools (DDS, 2017) | Commercial/Available at student edition | **Size**: P, Topometry  **Shape:** P**,** NP, Topography  **Topology:** TO (SIMP) | Compliance, eigenfrequency | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic), casting (pull direction), extrusion, user-defined manufacturing constraints | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.femtools.com/products/ftopt.htm> |
| ForcePAD (2015) | Open source | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: No CAD interface  **Plots**: N/A | <http://forcepad.sourceforge.net/> |
| FREEFEM (2019) | Open source (collection of scripts) | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, Level Set) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: No CAD interface  **Plots**: N/A | <https://freefem.org/> |
| GENESIS (VR&D, 2019) | Commercial | **Size**: P, Topometry  **Shape:** P**,** NP, Topography  **Topology:** TO (SIMP), Lattice (homogenization) | Strain energy, mass, displacement, velocity, acceleration, stress, frequency, buckling load factor, moment of inertia, center of gravity, temperature | **Design**: dimensions, volume, mass, moment of inertia, center of gravity, lattices (size, type, strut thickness, density)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, stress, frequency, temperature, velocity, acceleration, buckling load factor  **Manufacturing**: preserved region, symmetry (planar, cyclic, pattern), casting, stamp, extrusion overhang (angle) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <http://www.vrand.com/products/genesis/> |
| LS-DYNA (DYNAmore, 2020) (LS-TaSC, LS-OPT) | Commercial | **Size**: P  **Shape:** P, NP  **Topology:** TO (OC, Projected Subgradient method) | Strain energy, frequency, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic), casting, extrusion, forge | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.lsoptsupport.com/> |
| MSC Nastran (HEXAGON, MSC 2020) | Commercial/Available at student edition | **Size**: P, Topometry  **Shape:** P, NP, Topography  **Topology:** TO (SIMP) | compliance, volume, mass, displacement, stress, temperature, frequency, buckling load factor, fatigue | **Design**: dimensions, volume, mass  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, frequency, buckling load factor, fatigue, temperature, stress  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic), extrusion | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities (normalized densities) | <https://www.mscsoftware.com/product/msc-nastran> |
| OPTISHAPE-TS (  Quint Corporation, 2020) | Commercial | **Size**: N/A  **Shape:** NP, Topography (bead)  **Topology:** TO (SIMP) | compliance, volume, mass, displacement, frequency | **Design**: dimensions, volume, mass  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic, axial, section) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.quint.co.jp/eng/pro/ots/index.htm> |
| ParetoWin (SciArt, 2016) | Commercial/Available at student edition | **Size**: N/A  **Shape:** N/A  **Topology:** TO (Level Set), Generative design | compliance, weight, volume, displacement, strength, frequency | **Design**: dimensions, volume, weight  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar), pull direction, AM (support minimization) | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.sciartsoft.com/pareto> |
| ParetoWorks (SciArt, 2016) | add-in to SolidWorks  Commercial/Available at student edition | **Size**: N/A  **Shape:** N/A  **Topology:** TO (Level Set), Generative design | stiffness, volume, strength, frequency | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, frequency, stress  **Manufacturing**: preserved region, member size, pull direction, symmetry (planar, cyclic) | **Optimized design**: faceted geometry **Plots**: stresses | <https://www.sciartsoft.com/pareto> |
| ProTOp (CAESS, 2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** NP  **Topology:** TO (Level Set), Lattice (homogenization) | Strain energy, frequency | **Design**: dimensions, volume, lattices (size, type, strut thickness, fillet radius, orientation)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads, stress  **Manufacturing**: preserved region, member size, symmetry (planar, axial, cyclic, section, pattern) | **Optimized design**: faceted geometry **Plots**: stresses | <https://www.caess.eu/> |
| Inspire (Altair, 2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** Topography  **Topology:** TO (SIMP), Lattice (uniform) | Stiffness, mass, frequency | **Design**: dimensions, mass, center of gravity, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, pull direction, extrusion, symmetry (planar, cyclic), AM (overhang) | **Optimized design**: geometry recreating using PolyNURBS  **Plots**: stress, strain, displacement | <https://www.altair.com/resource/altair-inspire-accelerate-simulation-driven-design> |
| TopOpt | Open source (collection of matlab and python scripts and interactive apps) | **Size**: N/A  **Shape:** NP  **Topology:** TO (SIMP, Level set) | Compliance, volume, mass, buckling | **Design**: dimensions, mass, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, pull direction, symmetry (planar, cyclic) | **Optimized design**: No CAD interface  **Plots**: N/A | <https://www.topopt.mek.dtu.dk/?q=node/11> |
| TopoBox and MetaBox (2016) | Open source | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, RAMP), Lattice | Compliance, volume | **Design**: dimensions, mass, volume, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic) | **Optimized design**: No CAD interface  **Plots**: N/A | <https://www.fema.se/index.html> |
| ToPy (2009) | Open source (collection of python scripts) | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Compliance, heat conduction, stress | **Design**: dimensions, mass, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, heat conduction, stress  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface  **Plots**: N/A | <https://github.com/williamhunter/topy> |
| Trinitas (2019) | Open source | **Size**: N/A  **Shape:** NP  **Topology:** TO (OC) | Stiffness, weight, stress, frequency, buckling load factor | **Design**: dimensions, weight  **Supports and connections**: fixtures, contacts  **Loads**: structural loads frequency, stress  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface  **Plots**: N/A | <http://www.solid.iei.liu.se/Offered_services/Trinitas/index.html> |
| Creo (ptc, 2020) | Commercial | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, RAMP), Generative design | strain energy, mass, stress, displacement, strain, moment of Inertia, reaction force, frequency, heat transfer compliance | **Design**: dimensions, mass, moment of Inertia  **Supports and connections**: fixtures, contacts, displacement, stress, strain  **Loads**: structural loads, reaction force, frequency  **Manufacturing**: preserved region, member size, extrusion, pull direction, symmetry (planar, cyclic, pattern) | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.ptc.com/en/products/creo> |
| ANSA (BETA, 2020) (Tosca, Nastran sol 200) | Commercial | **Size**: P  **Shape:** NP, P, Topography (optimal bead layout to improve bending stiffness or vibration)  **Topology:** TO (SIMP, RAMP, MMA) | Strain energy, volume, weight, displacement, rotation, frequency, reaction force, reaction moment, internal force, internal moment, center of gravity, moment of Inertia | **Design**: dimensions, volume, weight, center of gravity, moment of Inertia  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  , frequency, reaction force, reaction moment, internal force, internal moment, rotation  **Manufacturing**: preserved region, member size, symmetry (planar, rotational, cyclic, point), mold (pull direction) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | <https://www.beta-cae.com/> |
| GetFEM++ (2020) | Open source (collection of scripts) | **Size**: N/A  **Shape:** P  **Topology:** TO (SIMP) | Stiffness, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface **Plots**: N/A | <https://getfem.org/index.html> |
| Python (2020) | Open source (collection of scripts):   * topopt.py (SIMP, 2D) * BESO\_Basic.py (BESO, 3D) | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, BESO) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface **Plots**: N/A | <https://www.topopt.mek.dtu.dk/apps-and-software/topology-optimization-codes-written-in-python> |
| Matlab (MathWorks, 2020) | Open source (collection of scripts):   * top.m (SIMP, 2D) * top88.m (SIMP, 2D) * top99neo.m (SIMP, 2D) * top3D125.m (SIMP, 3D) * topBuck250.m (SIMP, 2D) * topcut.m (Level Set, 2D) * TopOpt2.nb (Level Set, 3D) * CISM SCRIPT SOFTBESO (BESO, 2D) | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, Level Set, BESO) | Compliance, volume, buckling load factor | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, buckling load factor  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface **Plots**: N/A | <https://www.topopt.mek.dtu.dk/apps-and-software> |
| MFEM (2020) | Open source C++ finite element library | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: No CAD interface **Plots**: N/A | <https://mfem.org/> |
| MoFEM (2020) | Open source C++ finite element library | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: No CAD interface **Plots**: N/A | <http://mofem.eng.gla.ac.uk/mofem/html/> |
| Z88Arion (2020) | Open source | **Size**: N/A  **Shape:** N/A  **Topology:** TO (OC) | Compliance, stress, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, stress  **Manufacturing**: preserved region | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://z88.de/> |
| Midas NFX (2015) | Commercial/Available at student edition | **Size**: P  **Shape:** N/A  **Topology:** TO (OC) | Compliance, volume | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, stress  **Manufacturing**: preserved region | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.midasoft.com/mechanical/products/midasnfx> |
| Autodesk Within Medical (Autodesk, 2016) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** Lattice (homogenization) | Compliance, volume | **Design**: dimensions, volume, lattices (size, type, strut thickness, density, orientation, fillet radius)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: faceted geometry **Plots**: stress, strain, displacement | <https://www.autodesk.eu/products/within-medical/overview?wcmmode=disabled> |
| Materialize 3-matic (materialize, 2020) | Commercial | **Size**: P  **Shape:** N/A  **Topology:** TO**:** post-processingLattice (member modeling) | Compliance, volume | **Design**: dimensions, volume, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.materialise.com/en/software/3-matic> |
| Grasshopper | Open source visual programming language that runs within Rhino (Rhinoceros, 2020) and contains the following optimization add-inns:   * Aneba (BESO, 2D-3D) * tOpos (SIMP, 2D-3D) * Monolith (Lattice) * Intralattice (Lattice) * TopOpt (SIMP, 2D-3D) * Pufferfish (Lattice) * Sandbox Topology (P) * Reindeer (P) * Strawberry Lab (Lattice) | **Size**: P  **Shape:** P  **Topology:** TO(SIMP, BESO)Lattice (uniform, member modeling, homogenization) | Compliance, volume, weight, displacement, frequency, reaction force | **Design**: dimensions, volume, weight, lattices (size, type, strut thickness, orientation)  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic), pull direction, extrusion | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stress, strain, displacement | <https://www.rhino3d.com/6/new/grasshopper/> |
| Ameba (2019) | Commercial | **Size**: N/A  **Shape:** N/A **Topology:** TO(BESO) | Stiffness, frequency | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.aneba.com/en/index.php> |
| OpenLSTO (2018) | Open source | **Size**: N/A  **Shape:** N/A  **Topology:** TO (Level Set) | compliance | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface **Plots**: N/A | <http://m2do.ucsd.edu/software/> |
| MSC Apex (HEXAGON, MSC 2020) (Nastran, Patran) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP), Generative design | Compliance, frequency, mass | **Design**: dimensions, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: N/A | https://www.mscsoftware.com/product/msc-apex |
| Simright Toptimizer (Simright, 2017) | Commercial online tool | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP), Generative design | stiffness | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.simright.com/apps/simright-toptimizer> |
| 3DXpert (3D Systems, 2019) | Commercial/Available at student edition | **Size**: N/A  **Shape:** N/A  **Topology:** Lattice (homogenization) | compliance | **Design**: dimensions, volume, lattices (size, type, strut thickness, orientation, density)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://www.3dsystems.com/software/3dxpert> |
| [Solid Edge](https://all3dp.com/1/top-design-for-additive-manufacturing-dfam-software/#solid-edge) (Siemens, 2020) | Commercial/Available at student edition | **Size**: N/A  **Shape:** N/A  **Topology:** Generative design | Mass, stress | **Design**: dimensions, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, stress  **Manufacturing**: preserved region, member size, extrusion, AM (overhang), symmetry (planar) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities | <https://solidedge.siemens.com/en/> |
| Paramatters (2020) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP), Lattice (uniform) | Compliance, mass, stress, strain, frequency | **Design**: dimensions, mass, lattices (size, type, strut thickness)  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, stress, strain, frequency  **Manufacturing**: preserved region, member size, AM (overhang), symmetry (planar) | **Optimized design**: STL  **Plots**: stress, strain, displacement | <https://paramatters.com/> |
| LimitState:FORM (LimitState, 2020) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (Theory of optimal trusses) | Buckling load factor, frequency, deflection, stress | **Design**: dimensions, mass **Supports and connections**: fixtures, contacts  **Loads**: structural loads, stress, , frequency, deflection, buckling load factor  **Manufacturing**: preserved region | **Optimized design**: parametrized geometry  **Plots**: deflection, buckling load factor | <https://limitstate3d.com/limitstateform> |
| Openfoam (OpenCFD Ltd, 2020) | Open source C++ toolbox | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Compliance, mass | **Design**: dimensions, mass **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: No CAD interface **Plots**: N/A | <https://www.openfoam.com/> |
| Diabatix (Biabatix, 2019) | Commercial | **Size**: P  **Shape:** P  **Topology:** TO (SIMP) | Thermal compliance, weight, temperature, heat flux, thermal deformation | **Design**: dimensions, mass **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, member size (tool size), CNC milling, 3D printing, casting, extrusion, forging, hydroforming, injection molding | **Optimized design**: STL  **Plots**: N/A | <https://www.diabatix.com/> |
| Toptimiz3D (OMEVA, 2020) | Open source (python script+GUI) for FreeFem++ | **Size**: N/A  **Shape:** N/A  **Topology:** TO (MMA, OC, SIMP) | Stiffness, mass, volume | **Design**: dimensions, mass, volume **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: faceted geometry  **Plots**: N/A | <https://matematicas.uclm.es/omeva/> |
| OpenMDAO (OpenMDAO, 2020) | Open source | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, Level Set) | Compliance, mass, volume | **Design**: dimensions, mass, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: No CAD interface  **Plots**: N/A | <https://openmdao.org/> |
| Virtual.pyxis (Virtual.pyxis, 2014) (ANSYS, Nastran, Abaqus) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (OC, SIMP) | Compliance, frequency | **Design**: dimensions, mass, volume  **Supports and connections**: fixtures, contacts, frequency  **Loads**: structural loads  **Manufacturing**: preserved region, member size, extrude, casting, symmetry (planar) | **Optimized design**: faceted geometry  **Plots**: elements with intermediate densities | <http://virtualpyxis.com.br/> |
| Caeses (FRIENDSHIP SYSTEMS, 2020) | Commercial | **Size**: P  **Shape:** P, NP  **Topology:** N/A | Mass, stiffness | **Design**: dimensions, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region | **Optimized design**: faceted geometry  **Plots**: N/A | <https://www.caeses.com/> |
| TOffeeAM (TOffeeAM, 2020) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Pressure, heat, temperature | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, turbulence kinetic energy, temperature  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: STL  **Plots**: N/A | <https://www.toffeeam.co.uk/> |
| ToOptix (ToOptix, 2019) | Open source python script than can be used as add-in to FreeCAD and Blender | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Compliance, heat | **Design**: dimensions  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, temperature  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface  **Plots**: N/A | <https://github.com/Foxelmanian/ToOptixUpdate> |
| Patran (HEXAGON, MSC 2020) (Nastran) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Compliance, frequency, mass | **Design**: dimensions, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.mscsoftware.com/product/patran> |
| Live Parts (Desktop Metal, 2018) | Commercial add-in for Generative Design in SolidWorks | **Size**: N/A  **Shape:** N/A  **Topology:** Generative Design | Compliance | **Design**: dimensions, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, frequency  **Manufacturing**: preserved region, member size, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: N/A | https://www.desktopmetal.com/products/live-parts |
| HELYX (engys, 2020) | Commercial | **Size**: N/A  **Shape:** P, NP  **Topology:** TO (SIMP, Level Set) | Pressure, mass flow, power, moment, pump efficiency, stress, turbulent noise, volume, torque, swirl | **Design**: dimensions, mass flow, volume, turbulent noice  **Supports and connections**: fixtures, contacts  **Loads**: structural loads, pump efficiency, stress, pressure, torque, swirl  **Manufacturing**: preserved region, member size, symmetry (planar, cyclic) | **Optimized design**: faceted geometry **Plots**: power | <https://engys.com/products/helyx> |
| SAP2000 (CSI, 2017) | Commercial (access to TO module via HP-TOCP C# script) | **Size**: P  **Shape:** P  **Topology:** TO (SIMP, OC) | Compliance | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: N/A | <https://www.csiamerica.com/products/sap2000> |
| CalculiX (1998) | Open source (access to TO module via a python script) | **Size**: N/A  **Shape:** N/A  **Topology:** TO (BESO) | Stiffness, stress | **Design**: dimensions, volume, mass  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: stress | http://www.calculix.de/  https://github.com/fandaL/beso |
| ACP OpDesign (ETA, BETA, 2019) (LS-TaSC, Tosca, Genesis) | Commercial | **Size**: P  **Shape:** NP, P, Topography (optimal bead layout to improve bending stiffness or vibration)  **Topology:** TO (SIMP, RAMP, MMA, Projected Subgradient method) | Strain energy, volume, weight, displacement, rotation, frequency, reaction force, reaction moment, internal force, internal moment, center of gravity, moment of Inertia | **Design**: dimensions, volume, weight, center of gravity, moment of Inertia  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  , frequency, reaction force, reaction moment, internal force, internal moment, rotation  **Manufacturing**: preserved region, member size, symmetry (planar, rotational, cyclic, point), mold (pull direction), extrusion, forge | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | https://www.beta-cae.com/opdesign.htm |
| CAE Fidesys (Fidesys, 2020) | Commercial | **Size**: N/A  **Shape:** N/A  **Topology:** TO (SIMP) | Strain energy, volume, stress | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | <https://cae-fidesys.com/products/desktop/> |
| Epilysis (BETA, 2020) | Commercial | **Size**: P, Topometry  **Shape:** NP, P, **Topology:** TO (SIMP, RAMP, MMA) | Strain energy, volume, weight, displacement, rotation, frequency, reaction force, reaction moment, internal force, internal moment, center of gravity, moment of Inertia | **Design**: dimensions, volume, weight, center of gravity, moment of Inertia  **Supports and connections**: fixtures, contacts, displacement  **Loads**: structural loads  , frequency, reaction force, reaction moment, internal force, internal moment, rotation  **Manufacturing**: preserved region, member size, symmetry (planar, rotational, cyclic, point), casting | **Optimized design**: faceted geometry **Plots**: elements with intermediate densities, stresses, displacements | https://www.beta-cae.com/epilysis.htm |
| Allaire\_Scilab | Open source script in Scilab | **Size**: N/A  **Shape:** NP **Topology:** TO (Level Set) | compliance | **Design**: dimensions, volume  **Supports and connections**: fixtures, contacts  **Loads**: structural loads  **Manufacturing**: preserved region, symmetry (planar) | **Optimized design**: No CAD interface **Plots**: N/A | http://www.cmap.polytechnique.fr/~allaire/levelset\_en.html |