SOL 200 Web App

The SOL 200 Web App is compatible with MSC Nastran and enables users to convert SOL 1xx BDF files to SOL 200. The web application features the ability to select design variables, an objective and design constraints. The subsequent SOL 200 BDF files may be exported from the web app and an optimization by MSC Nastran may be performed.

The web app differentiates itself from other pre/post-processors in 3 ways: 1) The web app is based on the latest web technology and is accessible from ordinary web browsers. 2) The web app features numerous validations to ensure each MSC Nastran entry has been configured correctly. These validations ensure BDF files are run ready for MSC Nastran and successful optimizations can be performed. 3) MSC Nastran entries are generated in real time. As changes to the variables, objective or constraints are made, the respective entries are instantly regenerated.

The SOL 200 Web App comes with additional web apps including the HDF5 Explorer, Machine Learning web app, Beams Viewer, PBMSECT web app, and more.

Capabilities

- Optimization Types: Size, Topometry, Topology and Topography
- Optimization Options:
  - Local Optimization
  - Sensitivity Analysis
  - Global Optimization
  - Parameter Study
  - Multi Model Optimization
  - Machine Learning
- Analysis Types
  - SOL 101 - Statics
  - SOL 103 - Normal Modes
  - SOL 105 - Buckling
  - SOL 107 - Direct Complex Eigenvalues
  - SOL 108 - Direct Frequency Response
  - SOL 110 - Modal Complex Eigenvalues
  - SOL 111 - Modal Frequency Response
  - SOL 112 - Modal Transient Response
  - SOL 144 - Static Aeroelastic Response
  - SOL 145 - Aerodynamic Flutter
  - SOL 400 - Implicit Nonlinear (Machine Learning only)
- Multidisciplinary Optimization - Specify different ANALYSIS types per SUBCASE
- INCLUDE file support
- Equation driven objective and constraints (DRESP2 and DEQATN)
- Objective and constraints dependent on multiple load cases or SUBCASEs (DRSPAN)
- CSV Import/Export - Generate hundreds of Variables, DLINK entries and Constraints
- Semi-automatic Nastran execution and live status updates
- Auto Plotting of Results - Line plots and bar charts
- Model Matching

Supported MSC Nastran Entries

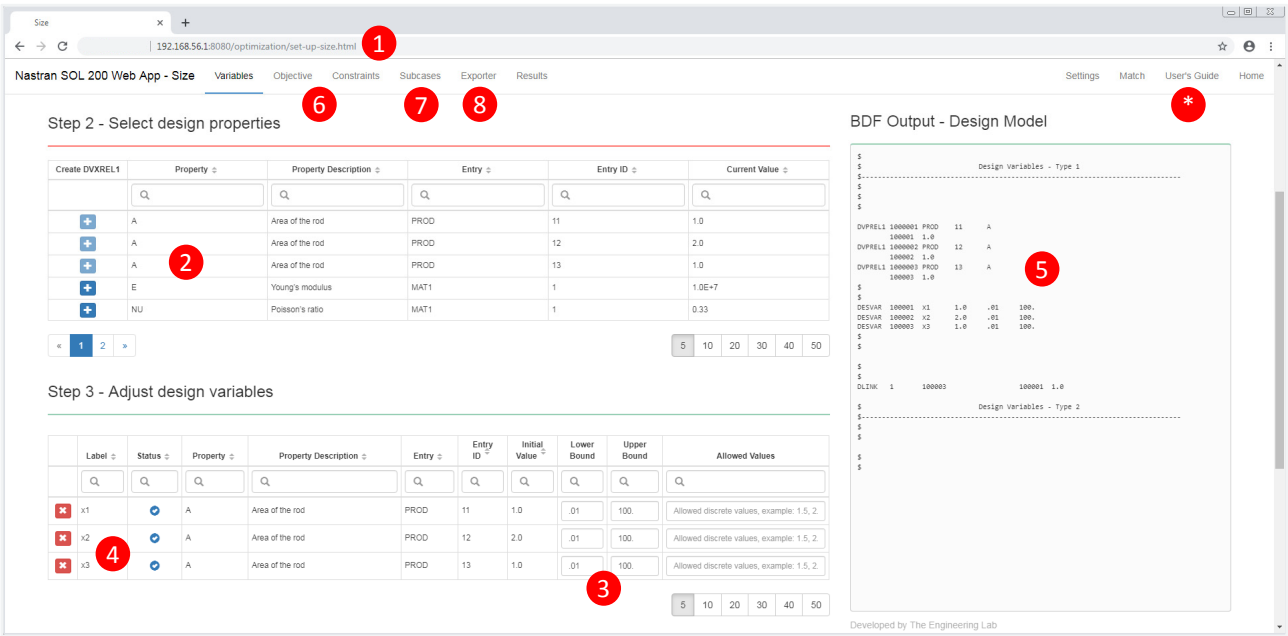
Bulk Data Entries	
BEADVAR	✓
DCONADD	✓
DCONSTR	✓
DDVAL	✓
DEQATN	✓
DESVAR	✓
DLINK	✓
DOPTPRM	✓
DRESP1	✓
DRESP2	✓
DTABLE	✓
DVXREL1	✓
DVXREL2	✓
TOMVAR	✓
TOPVAR	✓

Case Control Commands	
ANALYSIS	✓
DESGLB	✓
DESSUB	✓
DRSPAN	✓
DSAPRT	✓

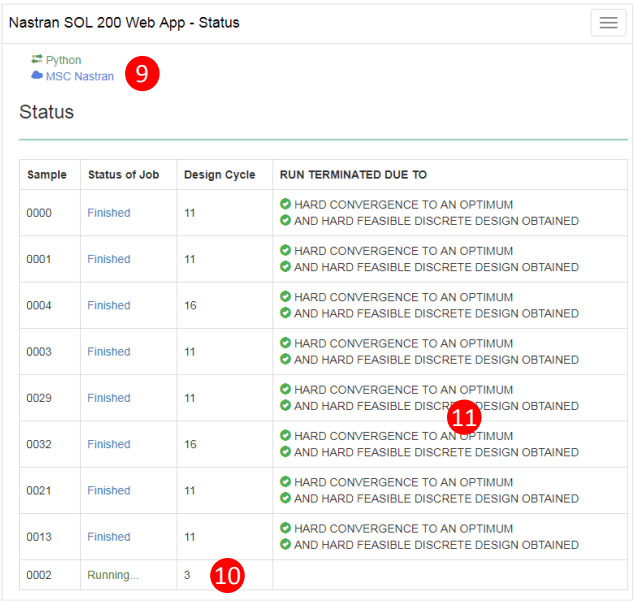
Workflow

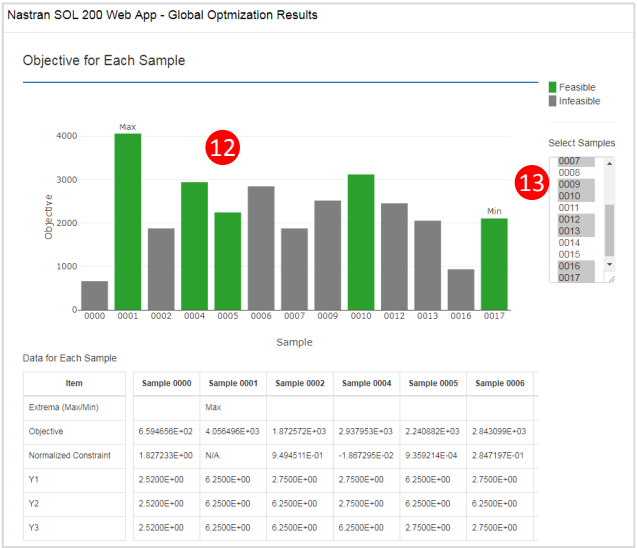
1. Open a web browser to access the web app and upload BDF files
2. Identify and set structural parameters as design variables, e.g. area, thickness, etc.
3. Configure the limits of design variables
4. Inspect the status or validation of each entry
5. Review Nastran entries that are instantly created and updated
6. Specify the objective, e.g. minimize weight, and constraints, e.g. stress limits
7. Assign design constraints to multiple load cases or configure multi-discipline optimization
8. Export SOL 200 BDF Files and automatically start Nastran

*Access dozens of tutorials in the User's Guide



9. Automatically start MSC Nastran
10. Track progress of each job
11. Review final status messages for each job
12. Automatically display results
13. Use controls to plot different quantities





Supported Designable Parameters

Entry	Properties
PACABS	CUTFR, B, K, M
PACBAR	MBACK, MSEPTM, FRESON, KRESON
PBAR	A, I1, I2, J, NSM, C1, C2, D1, D2, E1, D2, F1, F2, K1, K2, I12
PBARL	DIMi, NSM
PBEAM	(A(i), I1(i), I2(i), I12(i), J(i), NSM(i), C1(i), C2(i), D1(I), D2(i), E1(i), E2(i), F1(i), F2(i), i = A, B, 1 ... 9), K1, K2, S1, S2, (NSI(j), CW(j), M1(j), M2(j), N1(j), N2(j), j = A, B)
PBEAML	(DIMi(j), NSM(j), j = A, B, 1 ... 9)
PBRSECT/ PBMSECT	W (Overall Width), H(Overall Height),T(Overall Thickness) and T(n) Thickness of segment.
PBUSH	(Ki, Bi, GEi, i = 1, 6), SA, ST, EA, ET
PBUSH1D	K, C, M, SA, SE
PCOMP	Z0, NSM, SB, TREF, GE, Ti, THETAi
PDAMP	B1, B2, B3, B4
PELAS	K1, GE1, S1, K2, GE2, S2
PGAP	U0, F0, KA, KB, KT, MU1, MU2
PCOMPG	Z0, NSM, SB, TREF, GE
PMASS	M1, M2, M3, M4
PROD	A, J, C, NSM
PSHEAR	T, NSM, F1, F2
PSHELL	T, 12I/T**3, TS/T, NSM, Z1, Z2
PTUBE	OD, T, NSM
PVISC	CE1, CR1, CE2, CR2
GPLY	T, THETA
PWELD*	D
PFAST*	D, KT1, KT2, KT3, KR1, KR2, KR3, MASS, GE

* Not documented in Table 2-1 of the MSC Nastran Design Sensitivity and Optimization User's Guide but is supported by the DVPREL1 entry

Entry	Properties
Material Properties	
MAT1	E, G, NU, RHO, A, TREF, GE
MAT2	G11, G12, G13, G22, G23, G33, RHO, A1, A2, A3, TREF, GE
MAT3	EX, ETH, EZ, NUXTH, NUZTH, NUZX, RHO, GZX, AX, ATH, AZ, TREF, GE
MAT8	E1, E2, NU12, G12, G1Z, G2Z, RHO, A1, A2, TREF, Xt, Xc, Yt, Yc, S, GE
MAT9	G11, G12, G13, G14, G15, G16, G22, G23, G24, G25, G26, G33, G34, G35, G36, G44, G45, G46, G55, G56, G66, RHO, A1, A2, A3, A4, A5, A6, TREF, GE
MAT10	BULK, RHO, C, GE
Connectivity Properties	
CBAR	X1, X2, X3, W1A, W2A, W3A, W1B, W2B, W3B
CBEAM	X1, X2, X3, BIT, W1A, W2A, W3A, W1B, W2B, W3B
CBUSH	X1, X2, X3, S, S1, S2, S3
CDAMP2,4	B
CELAS2	K, GE, S
CELAS4	K
CGAP	X1, X2, X3
CMASS2,4	M
CONM1	M11, M21, M22, M31, M32, M33, M41, M42, M43, M44, M51, M52, M53, M54, M55, M61, M62, M63, M64, M65, M66
CONM2	M, X1, X2, X3, I11, I21, I22, I31, I32, I33
CONROD	A, J, C, NSM

Supported Responses for Objective and Constraints

DRESP1	Response Title
WEIGHT	Weight
VOLUME	Volume
EIGN	Eigenvalue
CEIG	Complex Eigenvalue
FREQ	Frequency
LAMA	Buckling Eigenvalue/Factor
DISP	Displacement
STRAIN	Strain
ESE	Element Strain Energy
STRESS	Stress
FORCE	Force
FATIGUE	Fatigue, pseudo-static fatigue analysis
FRFTG	Fatigue, random vibration fatigue analysis
SPCFORCE	Single Point Constraint Force
CSTRAIN	Strain in PCOMP or PCOMPG
CSTRESS	Stress in PCOMP or PCOMPG
CFAILURE	Composite Failure Criterion
CSTRAT	Composite Strength Ratio
TOTSE	Total Strain Energy
GPFORCE	Grid Point Force
GPFORCP	Grid Point Force, PARAM NEOLOP > 1
ABSTRESS	Beam Stresses referencing PBRSECT and PBMSECT
FRDISP	Displacement
PRES	Acoustic Pressure
FRVELO	Velocity
FRACCL	Acceleration
FRSPCF	Single Point Constraint Force
FRSTRE	Element Stress
FRFORC	Element Force
PSDDISP	Power Spectral Density Displacement
PSDVELO	Power Spectral Density Velocity
PSDACCL	Power Spectral Density Acceleration
RMSDISP	Root Mean Square Displacement
RMSVELO	Root Mean Square Velocity
RMSACCL	Root Mean Square Acceleration

DRESP1	Response Title
ACPWR	Acoustic Power through Radiated Surface, Panels
ACINTS	Acoustic Intensity Normal to Wetted Surface
AFPRES	Acoustic Pressure for Acoustic Field Point Mesh (AFPM)
AFINTS	Acoustic Intensity for Acoustic Field Point Mesh (AFPM)
AFVELO	Particle Velocities for Acoustic Field Point Mesh (AFPM)
AFPWR	Acoustic Power for Acoustic Field Point Mesh (AFPM)
DYSTIFF	Dynamic Stiffness Response
ERP	Equivalent Radiated Power (ERP)
TDISP	Displacement
TVELO	Velocity
TACCL	Acceleration
TSPCF	Single Point Constraint Force
TSTRE	Element Stress
TFORC	Element Force
STMONP1	Structural Integrated Load Monitor Point
STMOND1	Structural Displacement Monitor Point
MONPNT3	Integrated Load Monitor Point
AEMONP1	Aerodynamic Integrated Load Monitor Point
AEMOND1	Aerodynamic Displacement Monitor Point
TRIM	Trim Variable
STABDER	Stability Derivative
FLUTTER	Flutter Damping Value
DIVERG	Dynamic Response of the Selected Root
WMPID	Weight from Particular Material or Property ID
COMP	Compliance (Product of displacement and the applied load)
FRMASS	Fractional Mass

Supported Bulk Data Entries and Fields

The following depicts bulk data entries and their specific fields that are supported by the web app.

Index

Field not supported

BEADVAR	ID	PTYPE	PID	MW	MH	ANG	BF	SKIP
	DESVAR	NORM/XD	YD	ZD	CID	XLB	XUB	DELXV*
	GRID	NGSET	DGSET					

DCONADD	DCID	DC1	DC2	DC3	-etc.-			

DCONSTR	DCID	RID	LALLOW/LID	UALLOW/UID	LOWFQ	HIGHFQ		

DDVAL	ID	DDVAL 1	DDVAL 2	DDVAL 3	DDVAL4	DDVAL 5	DDVAL 6	DDVAL 7
	DDVAL 8	-etc.-						

DEQATN	EQID	EQUATION**
	EQUATION** (CONT.)	

DESVAR	ID	LABEL	XINIT	XLB	XUB	DELXV*	DDVAL	

DLINK	ID	DDVID	C0	CMULT	IDV1	C1	IDV2	C2
	IDV3	C3	-etc.-					

DRESP1	ID	LABEL	RTYPE	PTYPE	REGION	ATTA	ATTB	ATT1
	ATT2	-etc.-						

DRESP2	ID	LABEL	EQID or FUNC	REGION	METHOD	C1	C2	C3
	"DESVAR"	DVID1	DVID2	DVID3	DVID4	DVID5	DVID6	DVID7
		DVID8	-etc.-					
	"DTABLE"	LABL1	LABL2	LABL3	LABL4	LABL5	LABL6	LABL7
		LABL8	-etc.-					
	"DRESP1"	NR1	NR2	NR3	NR4	NR5	NR6	NR7
		NR8	-etc.-					
	"DNODE"	G1	C1	G2	C2	G3	C3	
		G4	C4	-etc.-				
	"DVPREL1"	DPIP1	DPIP2	DPIP3	DPIP4	DPIP5	DPIP6	DPIP7
		DPIP8	DPIP9	-etc.-				
	"DVCREL1"	DCIC1	DCIC2	DCIC3	DCIC4	DCIC5	DCIC6	DCIC7
		DCIC8	DCIC9	-etc.-				
	"DVMREL1"	DMIM1	DMIM2	DMIM3	DMIM4	DMIM5	DMIM6	DMIM7
		DMIM8	DMIM9	-etc.-				
	"DVPREL2"	DPI2P1	DPI2P2	DPI2P3	DPI2P4	DPI2P5	DPI2P6	DPI2P7
		DPI2P8	DPI2P9	-etc.-				
	"DVCREL1"	DCI2C1	DCI2C2	DCI2C3	DCI2C4	DCI2C5	DCI2C6	DCI2C7
		DCI2C8	DCI2C9	-etc.-				
	"DVMREL1"	DMI2M1	DMI2M2	DMI2M3	DMI2M4	DMI2M5	DMI2M6	DMI2M7
		DMI2M8	DMI2M9	-etc.-				
	"DRESP2"	NRR1	NRR2	NRR3	NRR4	NRR5	NRR6	NRR7
		NRR8	-etc.-					
	"DVLREL1"	DLIL1	DLIL2	DLIL3	DLIL4	DLIL5	DLIL6	DLIL7
		DLIL8	-etc.-					

DTABLE	LABL1	VALU1	LABL2	VALU2	LABL3	VALU2	LABL4	VALU4
	LABL5	VALU5	-etc.-					

DVCREL1	ID	TYPE	EID	CPNAME	CPMIN*	CPMAX*	C0	
	DVID1	COEFF1	DVID2	COEF2	DVID3	COEF3	-etc.-	

DVMREL1	ID	TYPE	MID	MPNAME	MPMIN*	MPMAX*	C0	
	DVID1	COEFF1	DVID2	COEF2	DVID3	COEF3	-etc.-	

DVPREL1	ID	TYPE	PID	PNAME/FID	PMIN*	PMAX*	C0	
	DVID1	COEFF1/'PVAL'	DVID2	COEF2	DVID3	COEF3	-etc.-	

DVCREL2	ID	TYPE	EID	CPNAME	CPMIN	CPMAX	EQID	
	"DESVAR"	DVID1	DVID2	-etc.-				
	"DTABLE"	LABL1	LABL2	-etc.-				

DVMREL2	ID	TYPE	EID	MPNAME	MPMIN	MPMAX	EQID	
	"DESVAR"	DVID1	DVID2	-etc.-				
	"DTABLE"	LABL1	LABL2	-etc.-				

DVPREL2	ID	TYPE	PID	FNAME	PMIN	PMAX	EQID	
	"DESVAR"	DVID1	DVID2	-etc.-				
	"DTABLE"	LABL1	LABL2	-etc.-				

TOMVAR	ID	TYPE	PID	PNAME/FID	XINIT	XLB	XUB	DELXV*
	DLINK	TID	C0	C1				
	DDVAL	DSVID						

TOPVAR	ID	LABEL	PTYPE	XINIT*	XLB*	DELXV*	POWER*	PID
	SYM	CID	MS1	MS2	MS3	CS	NCS	
	CAST	CID	DD	DIE	ALIGN			
	EXT	CID	ED	ALIGN				
	TDMIN	TMIN	TVMAX					
	STRESS	STLIM						

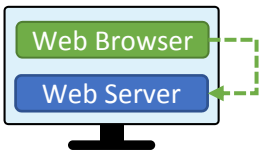
* The field is imported and exported but is not configurable within the web app. A text editor is recommended to edit the indicated field.

** The special DEQATN functions, e.g. AVG, SUM, ..., are supported.

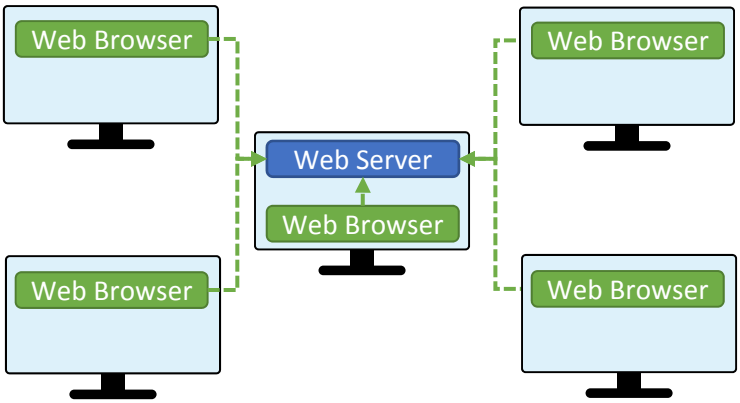
Installation Requirements

Installation Configurations

Configuration 1 - Desktop



Configuration 2 - Network



Web Browser Requirements

At least one of the web browsers listed below should be installed to access the SOL 200 Web App.

	Supported Versions	
Web Browser	**Windows 10**	**Linux (RHEL 7.x)**
Google Chrome	2021 - Present (v88.0.4324.104 - Present)	2021 - Present (v88.0.4324.96 - Present)
Mozilla Firefox	2021 - Present (v85.0 - Present)	2021 - Present (v78.6.1 - Present)
Microsoft Edge*	2021 - Present (v88.0.705.56 - Present)	Browser not available on this platform

* Microsoft Edge Legacy is not supported. Use the new Microsoft Edge. Refer to your company's IT support team for assistance.

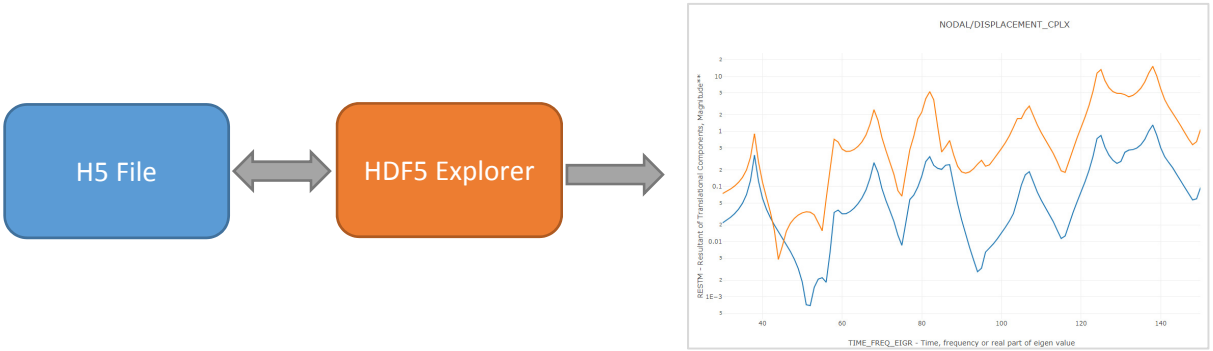
Web Server Requirements

Node JS is a free open-source application that will run a web server and host the SOL 200 Web App to other machines.

	Supported Versions	
Application	**Windows 10**	**Linux (RHEL 7.x)**
Node JS	2021 - Present (v14.15.4 - Present)	2021 - Present (v14.15.4 - Present)

HDF5 Explorer

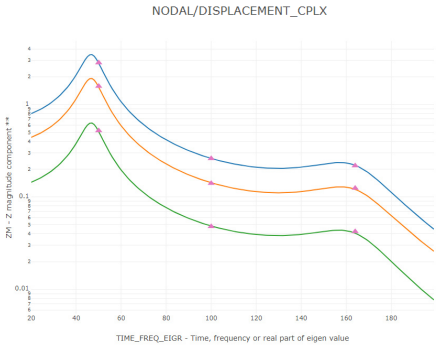
The HDF5 Explorer is used to automatically extract results data from the MSC Nastran HDF5 file (.h5) and automatically generate multiple plots. The HDF5 Explorer reduces the amount of work necessary to extract data and create plots. With traditional tools, the process to create one plot involves the following: 1) Extract 2-3 datasets. Dataset A contains the values to plot. Dataset B contains the respective Subcase and Frequency/Time values. 2) Combine the 2-3 datasets together. 3) Sort and separate the data by Subcase, Grid ID, etc. 4) Specify the horizontal and vertical axis. 5) Create the final plot. The HDF5 Explorer fully automates steps 1-5 and includes additional plotting options. The HDF5 Explorer is included in the SOL 200 Web App.



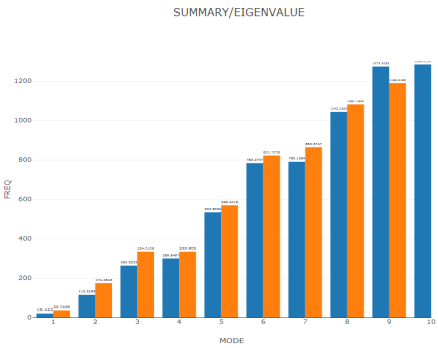
Capabilities

- Extract FEA results from the HDF5 (.h5) file
  - Over 500 datasets supported
  - Supported Schema: v20182
- CSV download of extracted data
- Automatically generate multiple plots on startup
- Use the Plots Browser to navigate between plots
- Manually create and delete plots
- CSV download of plotted values
- Download PNG images of plots
- Plot Configuration Options:
  - Horizontal and Vertical Axis, e.g. displacement, stress, pressure, frequency, etc.
  - Filters, e.g. Subcase, Grid ID, Mode Number, etc.
  - Type: Scatter, Bar and Polar Plots

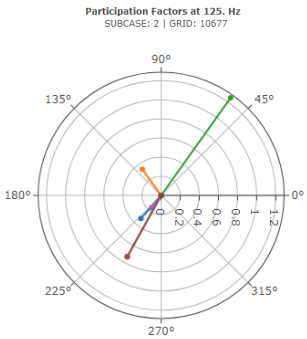
Supported Plot Types



Scatter Plots



Bar Charts



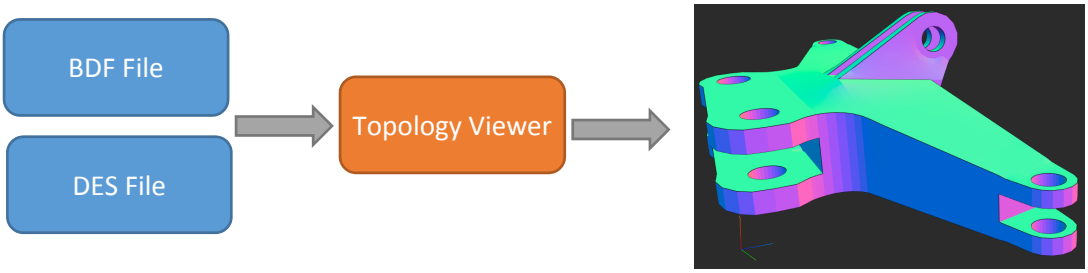
Polar Plots

Workflow

1. When the HDF5 Explorer is first started, multiple plots are automatically created and listed in the Plots Browser. Click on any icon to jump to that plot.
2. The values for the horizontal and vertical axis can be configured.
3. Use a filter to display plots for Subcases, Grid IDs, and other quantities.
4. A table of plotted values is available.
5. The table of plotted values can be downloaded to a CSV file.
6. An image of the plot can be downloaded.

Topology Viewer

The Topology Viewer allows users to display and adjust the results of a topology optimization all within the web browser. The new model can be downloaded to an STL file and moved to a separate CAD software application.

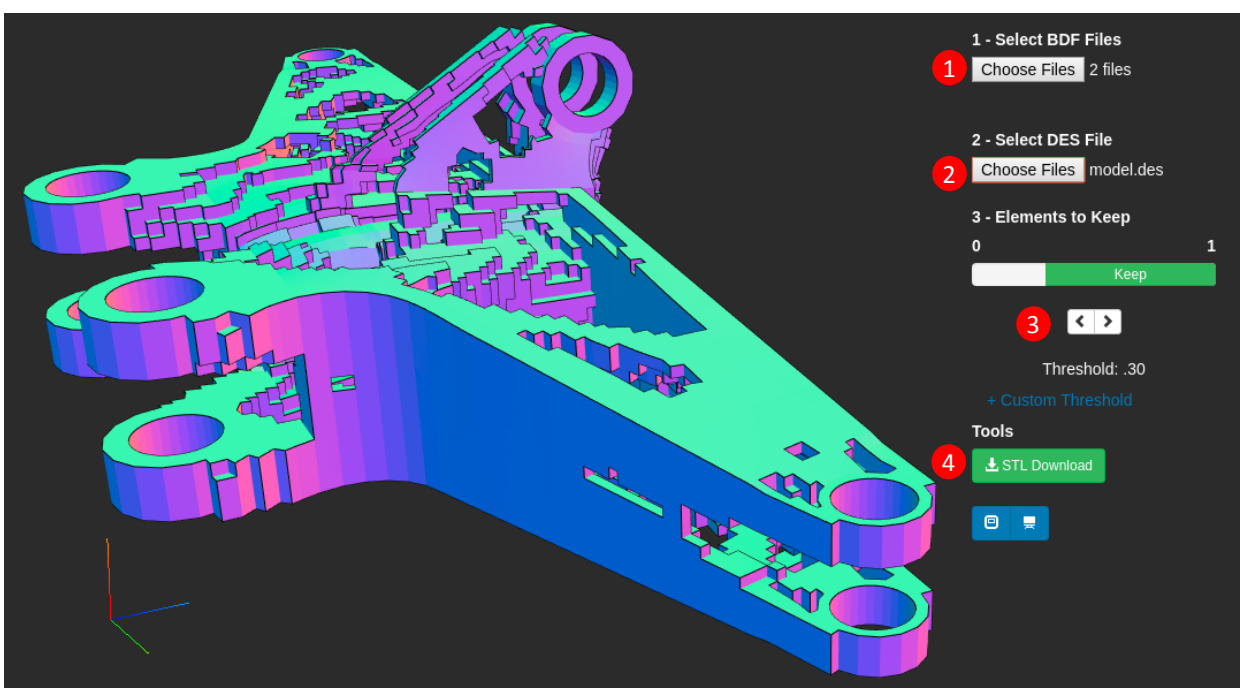


Capabilities

- Element Types
  - CTRIA3
  - CTRIA6
  - CTRIAR
  - CQUAD4
  - CQUAD8
  - CQUADR
  - CQUAD4
  - CQUAD8
  - CQUADR
  - CHEXA
  - CTETRA
  - CPENTA
  - All other elements are not supported
- Coordinate Systems
  - Only the basic coordinate system (CID=0) is supported for GRIDs. This is a rectangular Cartesian system and is also known as the default coordinate system.
  - All other coordinate systems are not supported. This includes cylindrical, spherical and other cartesian systems (CID=1, 2, 3…).
- STL Download/Export

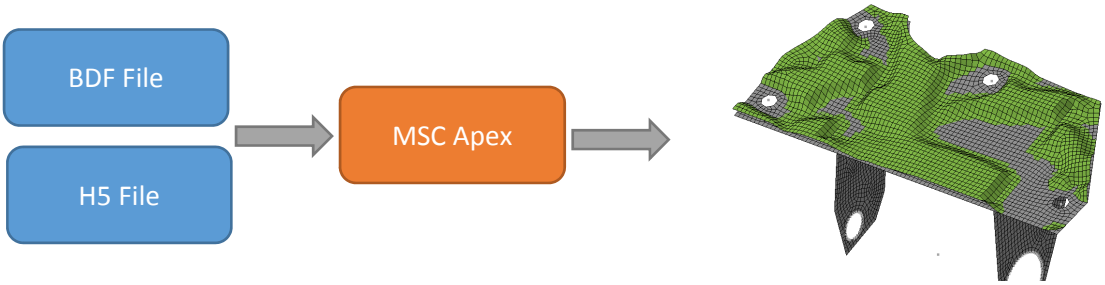
Workflow

1. Select the BDF Files.
2. Select the DES file containing the Topology Optimization results.
3. Adjust the elements to keep.
4. Download an STL file of the new model.



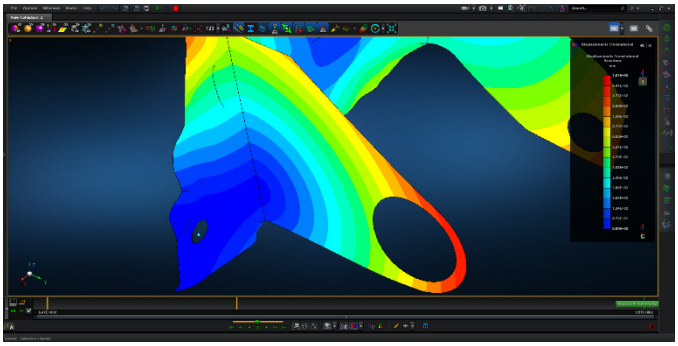
MSC Apex Support

A critical step during the optimization process is inspecting the newly optimized model. After an optimization is complete, the SOL 200 Web App automatically opens MSC Apex and the results of the optimization are displayed.



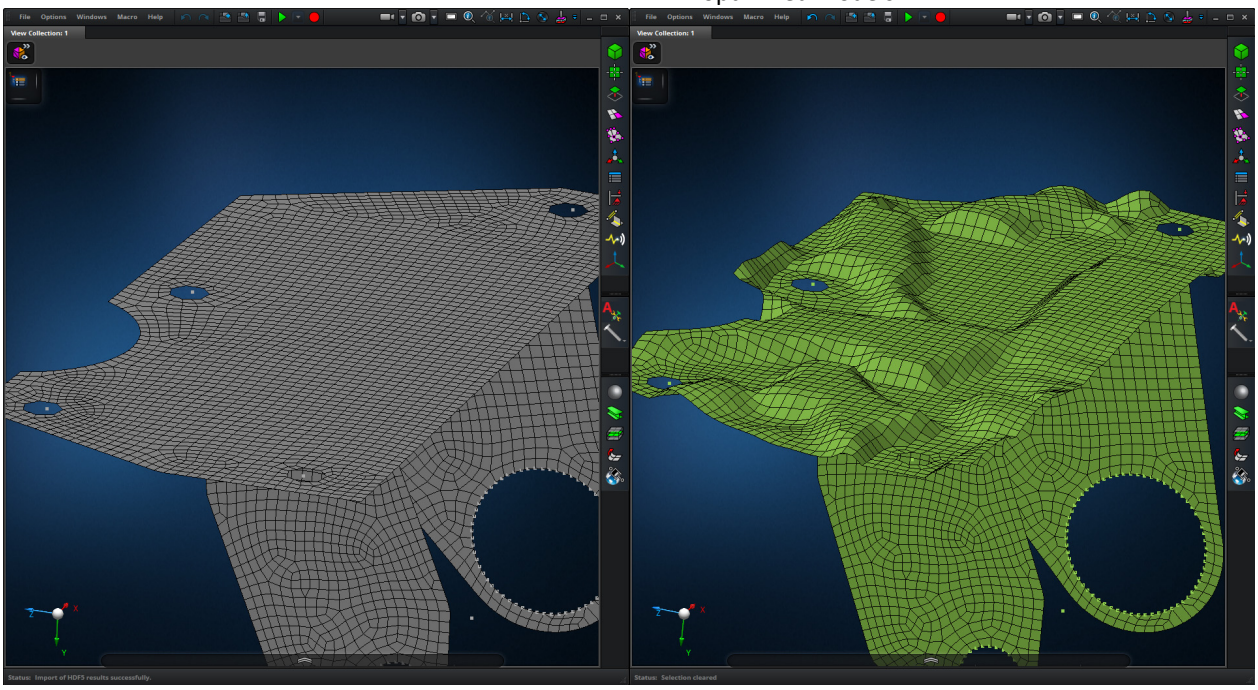
Capabilities

- Display optimized beam cross section dimensions or shell element thickness
- Review optimized responses for static or normal modes analysis (SOL 101 or 103)
- Supported versions: MSC Apex 2021 and 2021.1



Workflow

1. Perform and complete an optimization with either MSC Nastran SOL 200 or machine learning
2. Automatically open MSC Apex and display the original and optimized models
3. Make comparisons between the original and optimized models



Machine Learning

Gradient-based optimization has been demonstrated to be a reliable method in linear response optimization. For example, MSC Nastran SOL 200's optimization capability is applicable to solution sequences, 101, 103, 105, 107, 108, 110, 111, 112, 144 and 145. If a practitioner is interested in nonlinear response optimization, say with responses from SOL 400, gradient-based optimization is not as reliable.

The Machine Learning web app features active learning technology to optimize nonlinear responses, such as responses from SOL 400. Use this web app to define the parameters, objective and constraint responses; execute machine learning; and display live updates of the objective during the machine learning process.

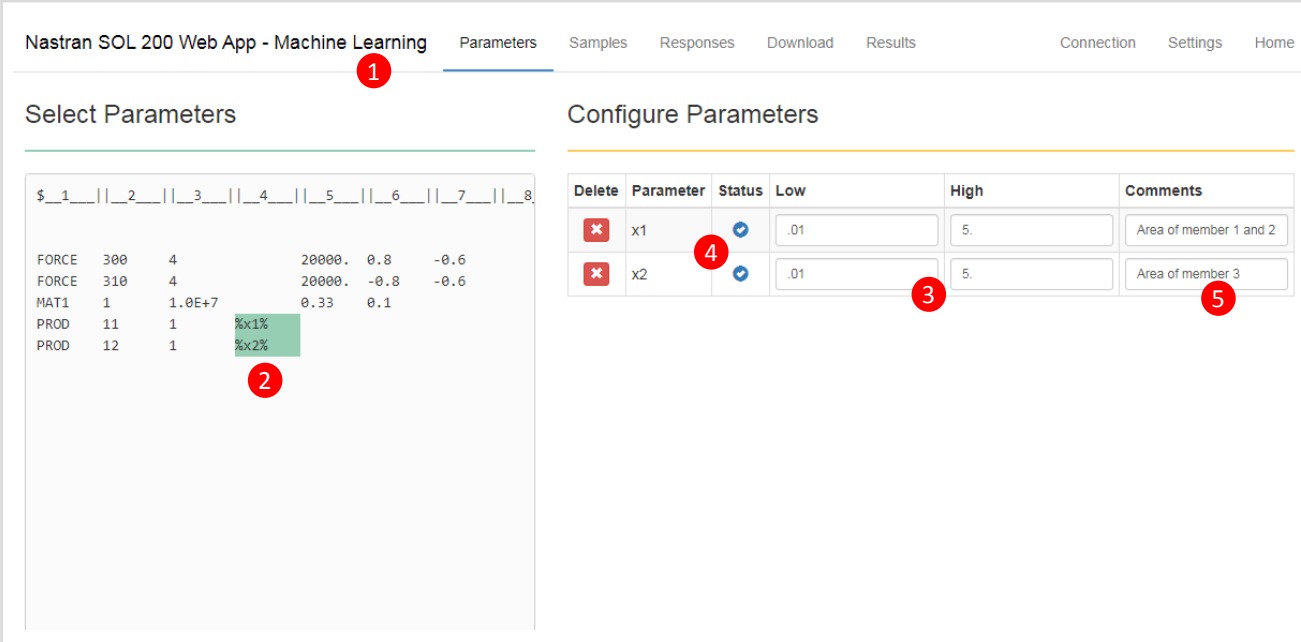
This web app is also used to configure a Parameter Study, or batch execution of multiple MSC Nastran runs. Use this web app to set up different configurations of the parameters via a Latin Hypercube Sampling, Taguchi or user-defined design. During the execution of each MSC Nastran run, the respective responses of interest are stored in a single CSV file for future post-processing of your choice.

Capabilities

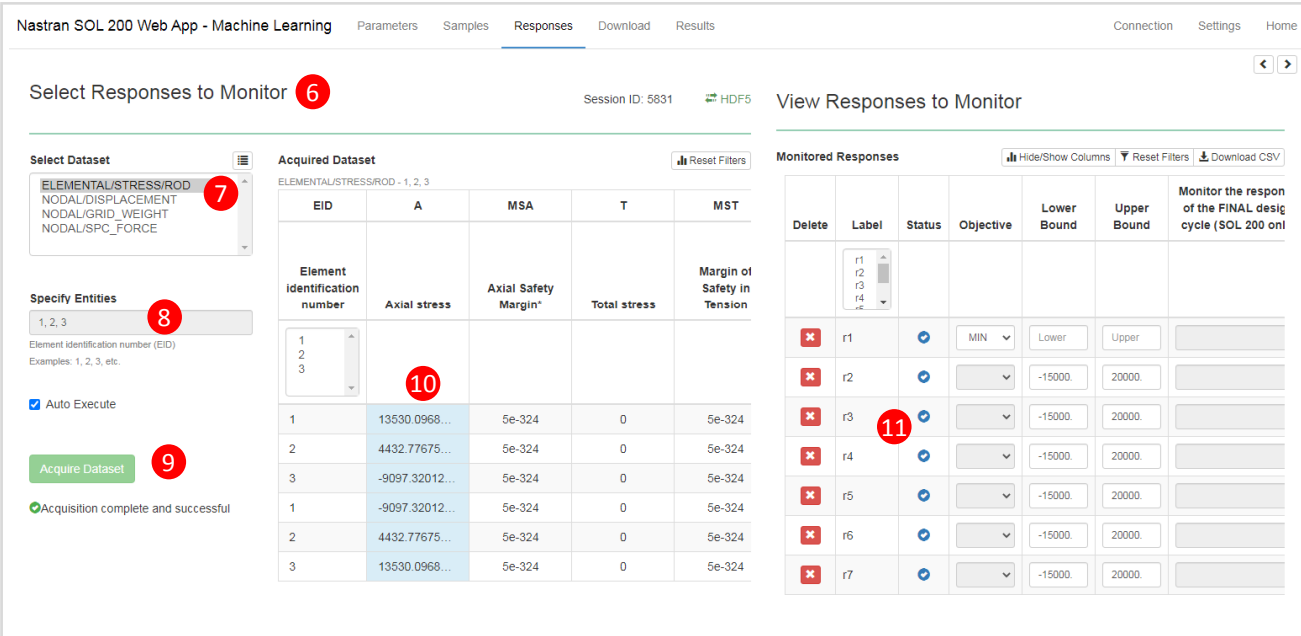
Supported file types	BDF, DAT, H5, CSV
Designs	• Latin Hypercube Sampling • Latin Hypercube Sampling, Reproducible • Mesh Grid • Taguchi • User-defined
Procedures	• Machine Learning (Bayesian Optimization) • Parameter Study (Batch Runs) • Local Optimization (Gradient Based Optimizer) • Sensitivity Analysis (Gradient Based Optimizer)
Supported MSC Nastran versions	2016-Present
Supported solution sequences (SOL xxx)	All except SOL 700

Workflow – Configure the Problem Statement's Parameters and Responses

1. Open a web browser to access the Machine Learning web app and upload the BDF files
2. Click a field on a Bulk Data entry to set the field as a parameter
3. Configure the bounds of the parameter
4. Inspect the status or validation of each parameter
5. Add additional comments to parameters for future identification

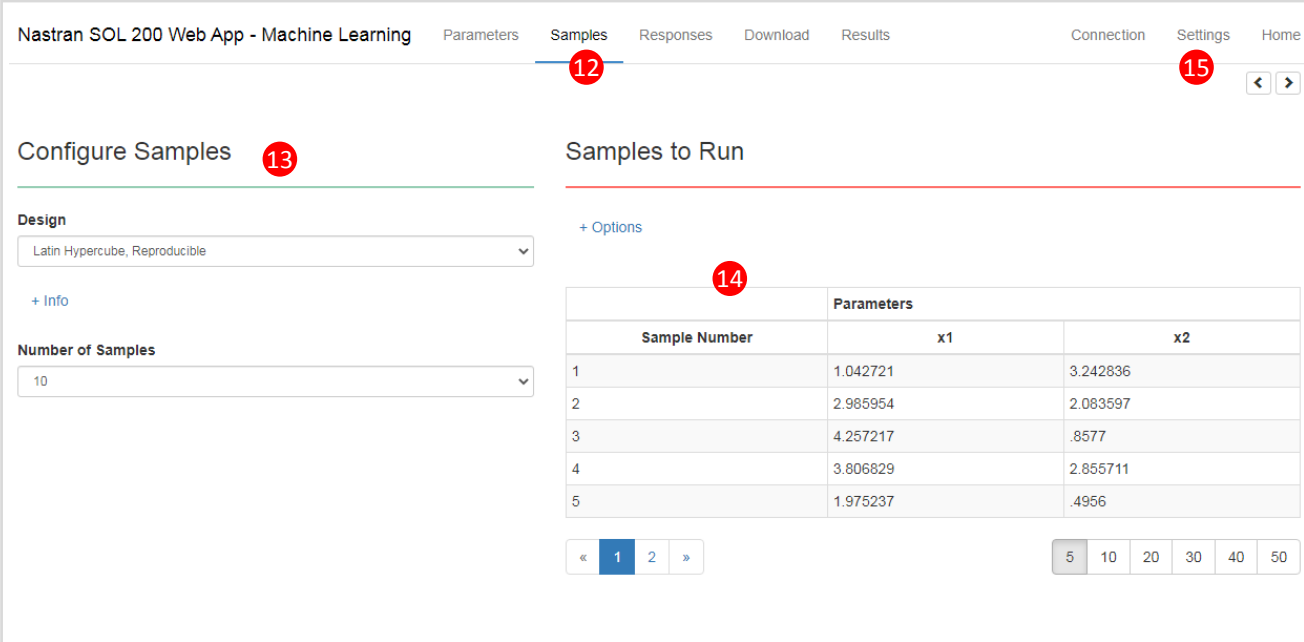


6. Upload the H5 file to make responses available for selection
7. Switch to other datasets to select additional responses to monitor
8. Specify entity IDs such as grid IDs or element IDs
9. Click Acquire Dataset to extract data from the H5 file
10. Select the table cell to track that specific response
11. View and configure responses to monitor

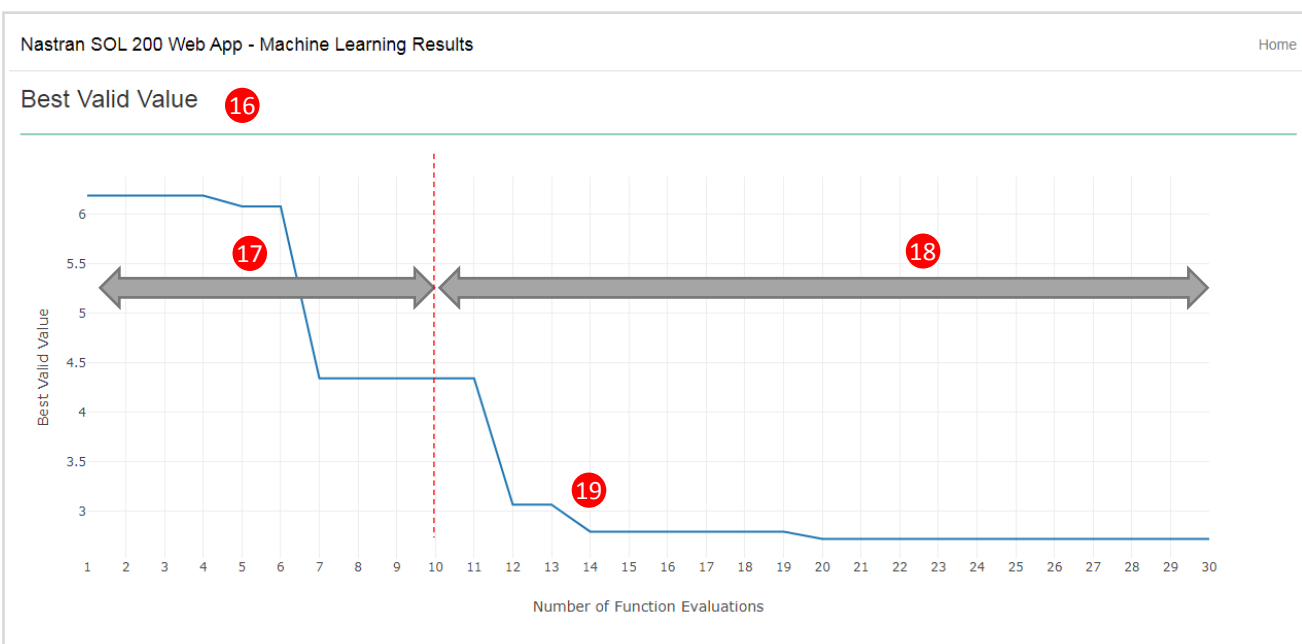


Workflow – Configure and Execute Machine Learning

12. Navigate to the Samples section to configure the design used to generate the initial training data
13. Specify the design type, e.g. Latin Hypercube Sampling (LHS), and specify the number of samples *n*
14. Inspect the different parameter configurations (samples)
15. Navigate to the Settings section and specify the Machine Learning procedure

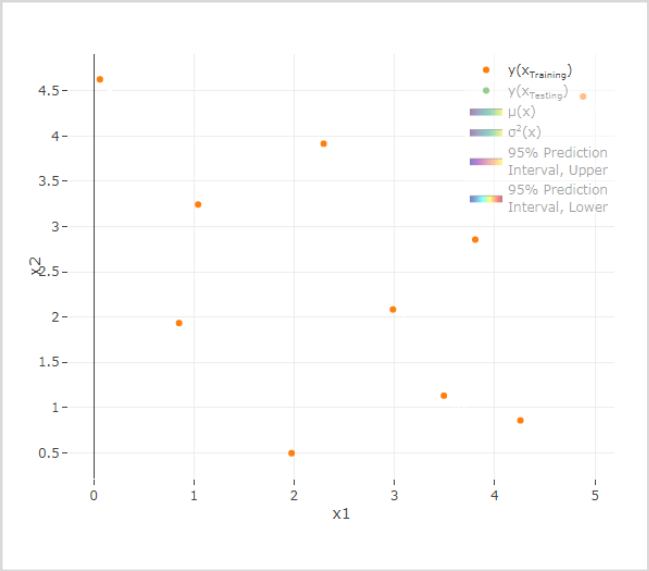


16. During the machine learning process, a live update of the optimization is displayed
17. The first *n* runs correspond to the samples used to generate the initial training data
18. The subsequent runs correspond to the machine learning iterations
19. Note the objective is minimized during the machine learning process

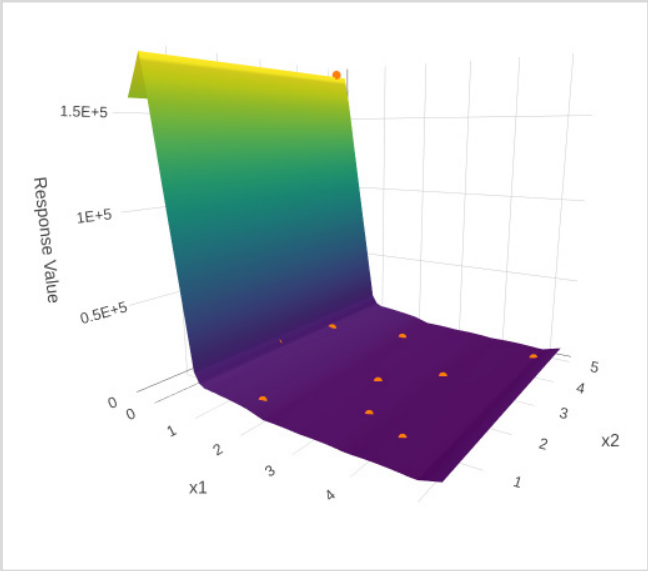


Workflow – Internal Process

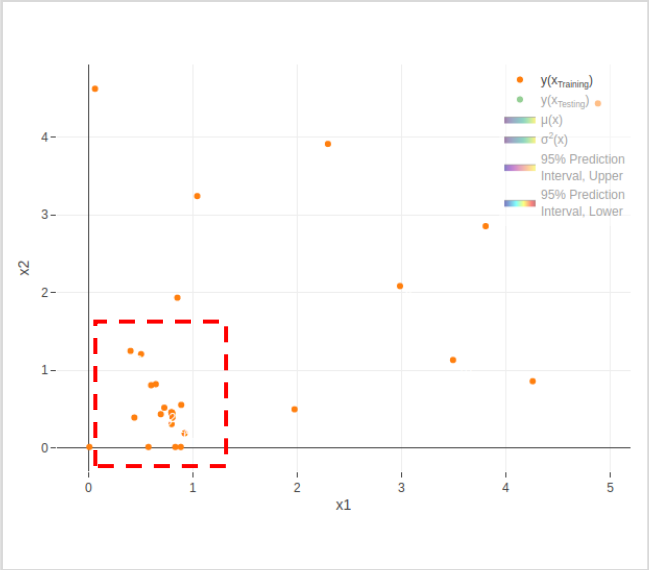
1. MSC Nastran is evaluated for each of the *n* samples previously configured. For each sample, or parameter/input configuration, the respective output responses are collected. These initial inputs and outputs are the training data.



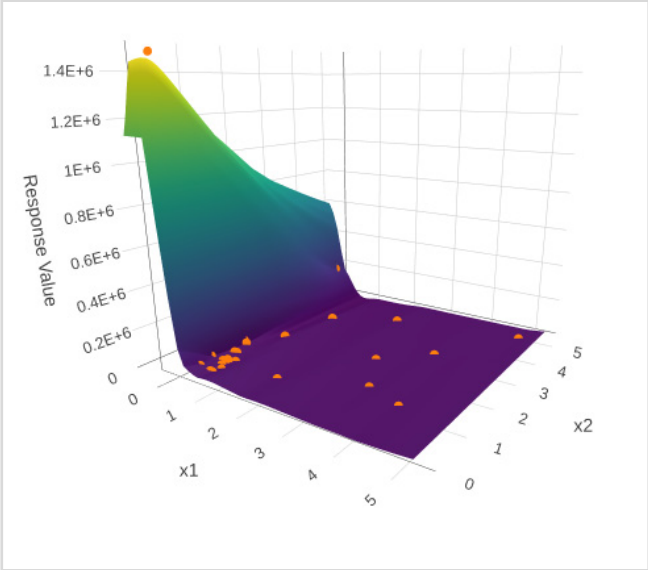
2. The initial inputs and outputs are used to train the starting surrogate models. Below is an example of a surrogate model for a stress response.



3. During the machine learning process, acquisition functions are used to determine candidate samples that are likely to yield a better design. For each candidate sample, MSC Nastran is used to evaluate that candidate. Eventually, new samples are close to each other, indicating the optimum is being approached.



4. With each new sample evaluated by MSC Nastran, the surrogate models are updated. In effect, the optimization is learning from previous experience.



Prediction Analysis

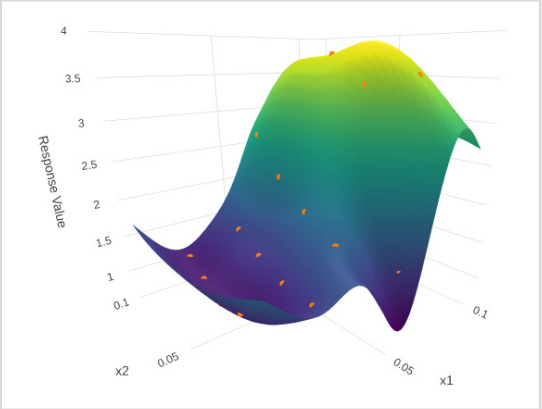
In some instances, finite element analysis can require hours to complete. If there is a need to run multiple finite element (FE) analyses, days or weeks may be required. Methods to determine the FE solver output with a limited number of FE analyses are desired.

The Prediction Analysis web app is used to construct surrogate models which are used to predict the output of the FE solver. To construct surrogate models, the FE solver is executed at different parameter configurations of the FE model, the outputs are collected, and Gaussian process (GP) regression is used to train the surrogate models. Any predictions made using the surrogate models are computed in seconds and is a contrast to FE analyses that sometimes span hours.

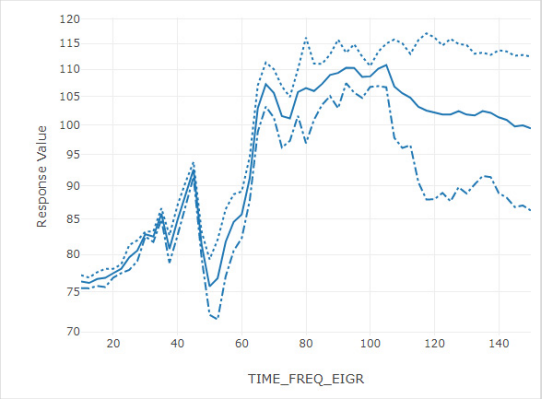
It should be noted that the Machine Learning web app can be used to configure multiple MSC Nastran runs and collect the output responses. The different FE configurations, or inputs, and output responses serve as the training data that the Prediction Analysis web app uses to construct the surrogate models.

Capabilities

Supported File Types	• CSV
Regression Type	• Gaussian process regression
Kernels (Covariance Functions)	• Matern 5/2 • Exponential • Radial Basis Function (RBF)
Outputs of Regression	• Mean (Prediction values) • Variance (Prediction uncertainty) • 95% Prediction Interval • Hyperparameter Values • Automatic Relevance Determination Values • Log Marginal Likelihood • Normalized Root Mean Square Error (NRMSE)
Plots	• Response Surface (plot of the mean function) for 1D or 2D parameter problems • Variance Bar Charts • XYPLOTs for frequency or transient responses
Parameter/ Variable Screening	• Automatic Relevance Determination



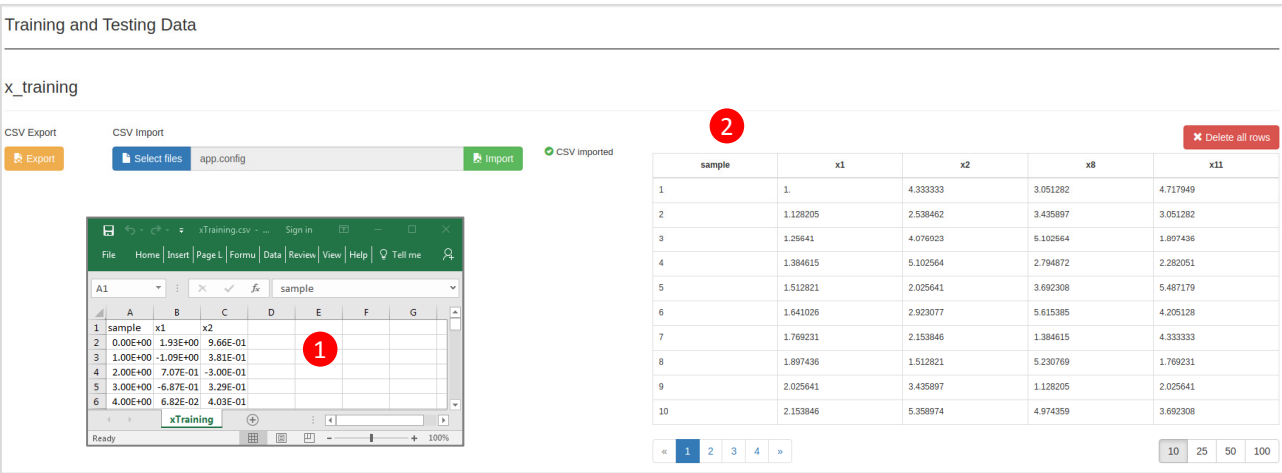
Displayed is an example of a surrogate model. Each point represents the output of the FE solver at different parameter configurations. The output was used to train the surrogate model.

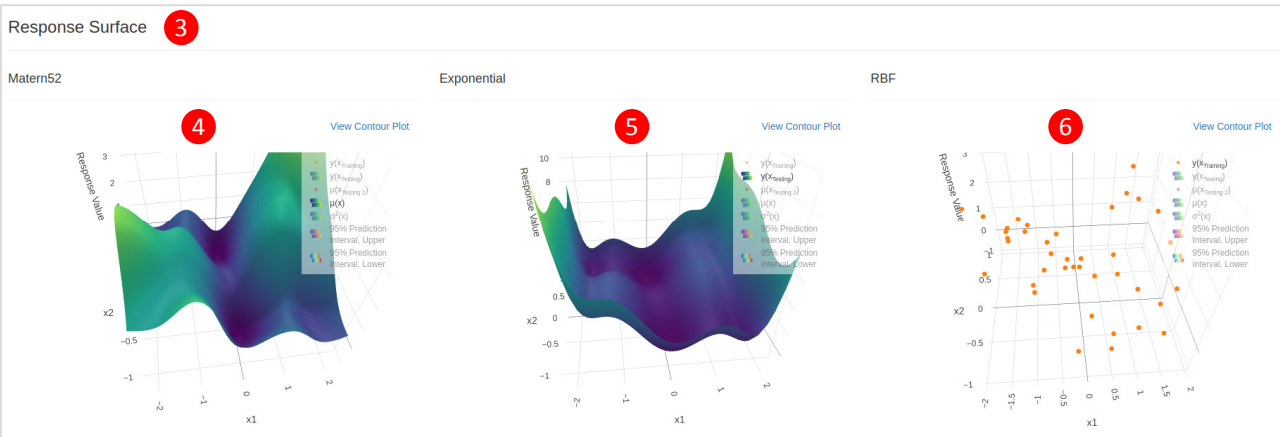


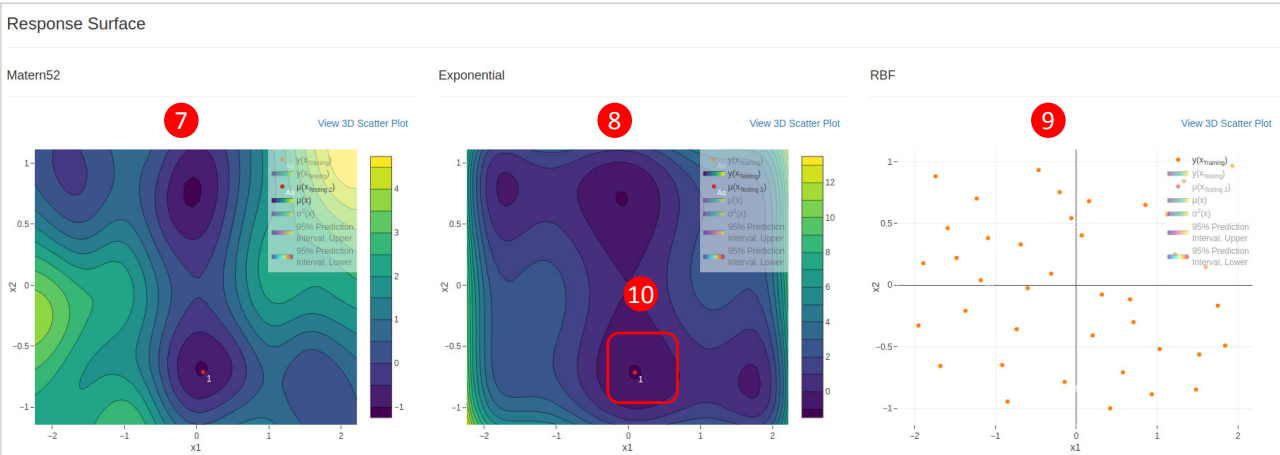
A plot of the predicted frequency response is displayed along with the 95% prediction intervals.

Workflow

1. Excel is used to customize CSV files that contain the training data
2. Training data, and optionally testing data, is uploaded to the Prediction Analysis web app
3. A regression is performed for 3 different kernel functions and the response surfaces are displayed
4. A plot of the surrogate model is displayed
5. A plot of the true function is displayed
6. The training data points are displayed
7. A contour plot of the surrogate model is displayed
8. A contour plot of the true function is displayed
9. The training data points are displayed
10. A prediction is made at the known minimum and coincides with the true minimum

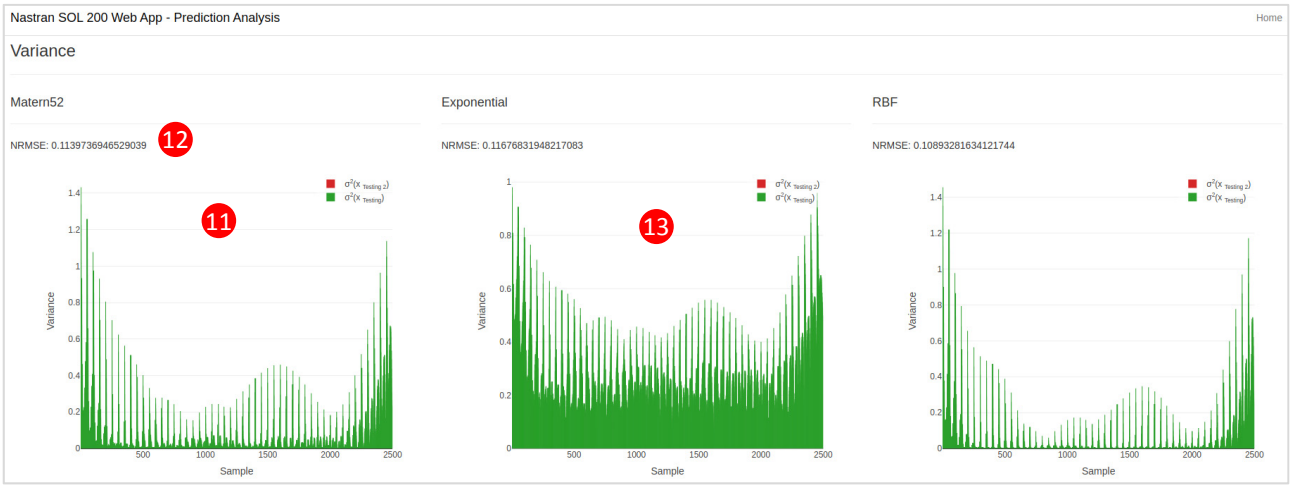


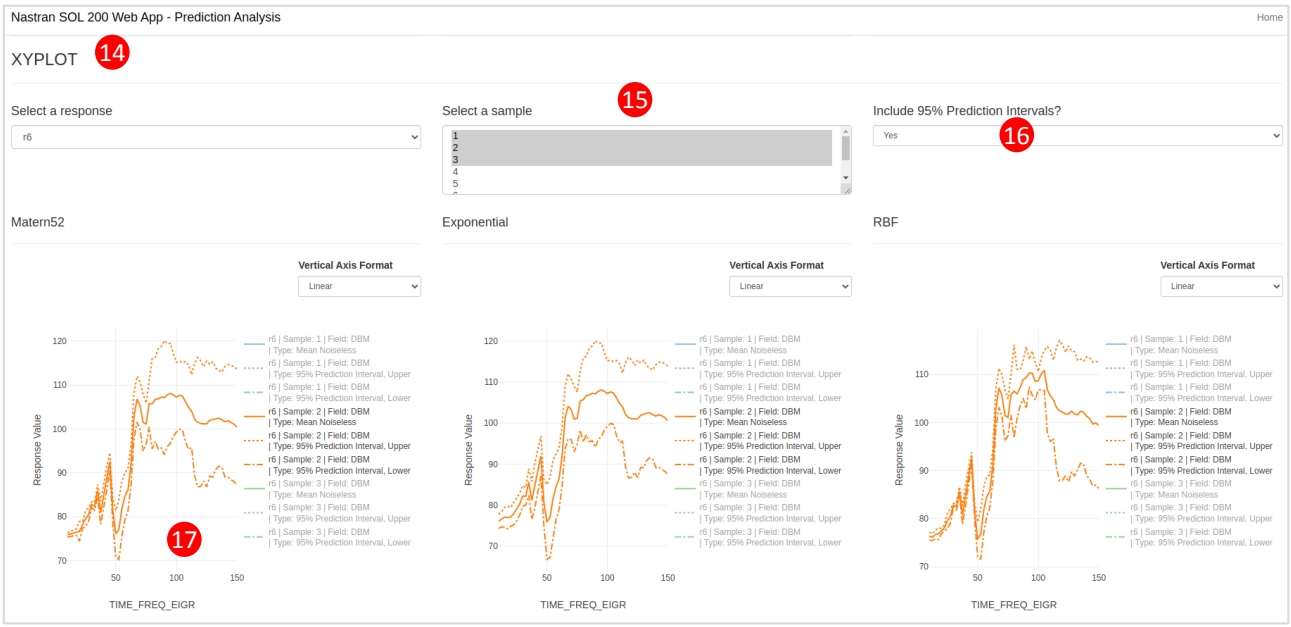




Workflow

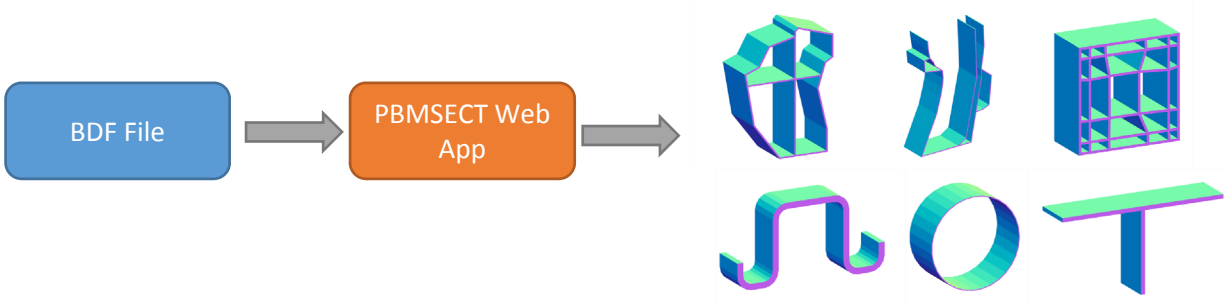
11. A variance bar chart is created and indicates the prediction uncertainty for the testing data points
12. If testing data was provided, the normalized root mean square error (NRMSE) is computed and displayed
13. Different kernel functions yield different levels of prediction uncertainty, note the higher variances when the exponential kernel was used
14. If the surrogate model corresponds to a frequency or transient response, an XYPLOT is constructed
15. The controls can be used to display a particular response or predictive sample
16. The 95% prediction intervals can be optionally displayed
17. Each change to the controls immediately updates the displayed XYPLOT





PBMSECT Web App

The PBMSECT web app is used to visually create arbitrary beam cross sections. The necessary PBMSECT and PBRSECT entries are automatically managed by the PBMSECT web app.



Capabilities

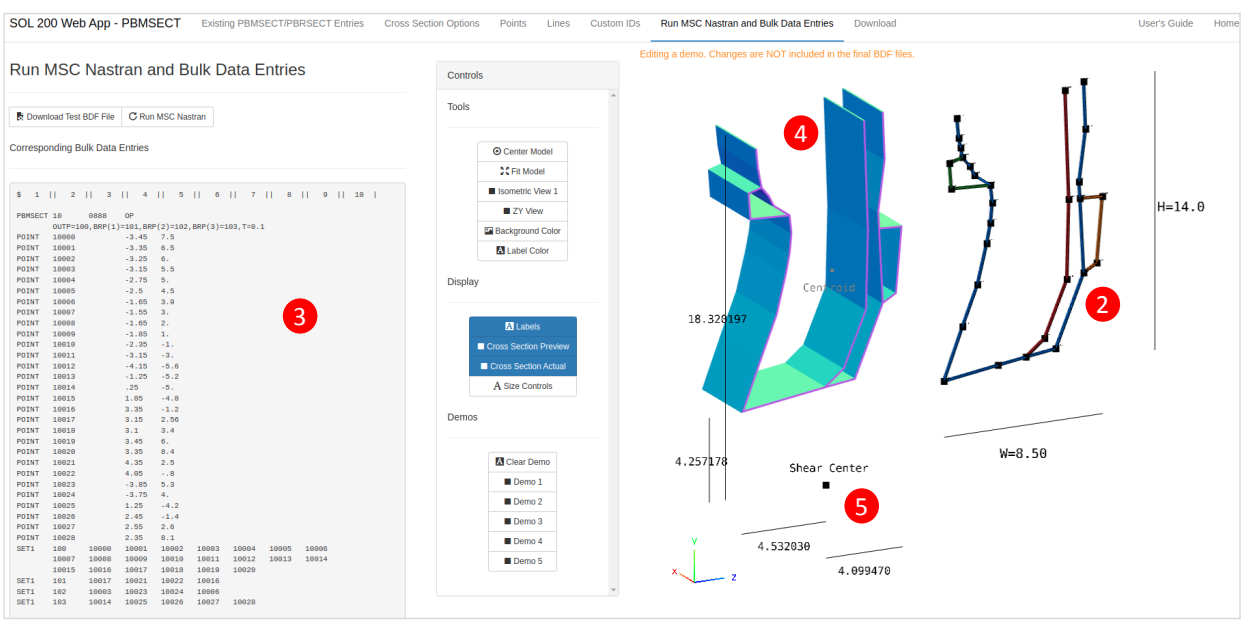
- Supported forms: GS – Generation Section, OP – Open Profile, CP – Closed Profile
- Composite arbitrary beam cross sections
- Supported keywords: OUTP, INP, BRP, T, CORE or C, LAYER or L, NSM. OUTM and BEGIN BULK ARBMODEL are NOT supported.

Supported Bulk Data Entries

Entry	Import	Export
PBMSECT	✓	✓
PBRSECT	✓	✓
POINT	✓	✓
SET1	✓	✓
SET3	✓	

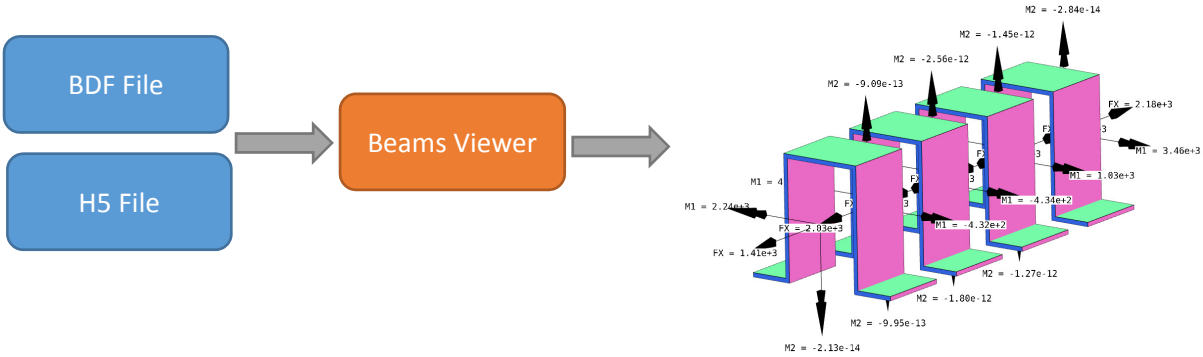
Workflow

1. Upload BDF files (Not shown)
2. Visually create the arbitrary beam cross section
3. View the corresponding PBMSECT, PBRSECT, POINT and SET1 entries
4. Run MSC Nastran to generate the actual arbitrary beam cross section
5. View cross section details such as location of shear center, centroid, width, height, and distance from shear center to outer fibers



Beams Viewer

The Beams viewer is used to visually confirm the placement and orientation of 1D elements used by MSC Nastran. There is minimal support for post processing the 1D element's internal forces such as shear forces and moments. There is no pre processing support. For example, the orientation of beams may not be edited in the Beams Viewer. Due to web browser limitations, a maximum BDF file size of 200KB may be uploaded to the Beams Viewer.



Capabilities

- Coordinate systems
  - Only the basic, or default, coordinate system is supported. Custom Cartesian, cylindrical or spherical coordinate systems are currently not supported.
- Tapered beams and stations are supported
- Display
  - GRID IDs
  - Element IDs
  - Orientation Vector
  - Element Coordinate System
  - Beam Shape (3D view of cross section)
  - Neutral Axis
  - Shear Center
  - End A to End B
  - GA to GB
- 1D Element Forces
  - Moments M1 and M2
  - Shear forces V1 and V2
  - Torque
  - Axial force
- 1D Element Stresses
  - Bending/Longitudinal at C, D, E, F
  - Axial
  - Torsion

Supported Bulk Data Entries

Entry	Import
BAROR	✓
BEAMOR	✓
CBAR	✓
CBARAO	✓
CBEAM	✓
CBEAM3	✓
CBEND	✓
CONROD	✓
CROD	✓
CTUBE	✓
PBAR	✓
PBARL	✓
PBCOMP	
PBEAM	✓
PBEAM3	✓
PBEAML	✓
PBEND	✓
PBMSECT	✓
PBRSECT	✓
PROD	✓
PTUBE	✓

Supported Bulk Data Entries and Fields

The following depicts bulk data entries and their specific fields that are supported by the Beams Viewer.

Index

- Field is supported and used to display the cross section of the 1D element
- Field or option is not supported

GRID	ID	CP • 0 or blank only	X1	X2	X3	CD	PS	SEID

BAROR		PID			X1	X2	X3	OFFT

BEAMOR		PID			X1	X2	X3	OFFT

CBAR	EID	PID	GA	GB	X1 G0	X2	X3	OFFT • GGG or blank only • BGG, GGO, etc.
	PA	PB	W1A	W2A	W3A	W1B	W2B	W3B

CBARAO	EID	SCALE • LE or FR	X1	X2	X3	X4	X5	X6

CBEAM	EID	PID	GA	GB	X1 G0	X2	X3	OFFT • GGG or blank only • BGG, GGO, etc.
	PA	PB	W1A	W2A	W3A	W1B	W2B	W3B
	SA	SB						

CBEAM3	EID	PID	GA	GB	GC Blank	X1 G0	X2	X3
	W1A	W2A	W3A	W1B	W2B	W3B	W1C	W2C
	W3C	TWA	TWB	TWC	SA	SB	SC	

CBEND	EID	PID	GA	GB	X1 G0	X2	X3	GEOM • 1, 2, 3, 4

CONROD	EID	G1	G2	MID	A	J	C	NSM

CROD	EID	PID	G1	G2				

CTUBE	EID	PID	G1	G2				

1. The GROUP must be MSCBML0 or blank. Custom libraries are not supported.
2. TYPEs supported: All sections (ROD, TUBE, …, DBOX). The shear center is not computed for BOX1, HAT1 and DBOX.

PBAR	PID	MID	A	I1	I2	J	NSM	
	C1	C2	D1	D2	E1	E2	F1	F2
	K1	K2	I12					

PBARL	PID	MID	GROUP[1]	TYPE[2]				
	DIM1	DIM2	DIM3	DIM4	DIM54	DIM6	DIM7	DIM8
	DIM9	-etc.-	NSM					

PBEAM	PID	MID	A(A)	I1(A)	I2(A)	I12(A)	J(A)	NSM(A)
	C1(A)	C2(A)	D1(A)	D2(A)	E1(A)	E2(A)	F1(A)	F2(A)
	SO	X/XB	A	I1	I2	I12	J	NSM
	C1	C2	D1	D2	E1	E2	F1	F2
	K1	K2	S1	S2	NSI(A)	NSI(B)	CW(A)	CW(B)
	M1(A)	M2(A)	M1(B)	M2(B)	N1(A)	N2(A)	N1(B)	N2(B)

PBEAM3	PID	MID	A(A)	IZ(A)	IY(A)	IYZ(A)	J(A)	NSM(A)
	CY(A)	CZ(A)	DY(A)	DZ(A)	EY(A)	EZ(A)	FY(A)	FZ(A)
	SO(B)		A(B)	IZ(B)	IY(B)	IYZ(B)	J(B)	NSM(B)
	CY(B)	CZ(B)	DY(B)	DZ(B)	EY(B)	EZ(B)	FY(B)	FZ(B)
	SO(C)		A(C)	IZ(C)	IY(C)	IYZ(C)	J(C)	NSM(C)
	CY(C)	CZ(C)	DY(C)	DZ(C)	EY(C)	EZ(C)	FY(C)	FZ(C)
	KY	KZ	NY(A)	NZ(A)	NY(B)	NZ(B)	NY(C)	NZ(C)
	MY(A)	MZ(A)	MY(B)	MZ(B)	MY(C)	MZ(C)	NSIY(A)	NSIZ(A)
	NSIYZ(A)	NSIY(B)	NSIZ(B)	NSIYZ(B)	NSIY(C)	NSIZ(C)	NSIYZ(C)	CW(A)
	CW(B)	CW(C)	STRESS • GRID or blank only • GAUSS					
	WC(A)	WYC(A)	WZC(A)	WD(A)	WYD(A)	WZD(A)	WE(A)	WYE(A)
	WZE(A)	WF(A))	WYF(A)	WZF(A)	WC(B)	WYC(B)	WZC(B)	WD(B)
	WYD(B)	WZD(B)	WE(B)	WYE(B)	WZE(B)	WF(B)	WYF(B)	WZF(B)
	WC(C)	WYC(C)	WZC(C)	WD(C)	WYD(C)	WZD(C)	WE(C)	WYE(C)
	WZE(C)	WF(C)	WYF(C)	WZF(C)				

PBEAML	PID	MID	GROUP[1]	TYPE[2]				
	DIM1(A)	DIM2(A)	-etc.-	DIMn(A)	NSM(A)	SO(1)	X(1)/XB	DIM1(1)
	DIM2(1)	-etc.-	DIMn(1)	NSM(1)	SO(2)	X(2)/XB	DIM1(2)	DIM2(2)
	-etc.-	DIMn(2)	NSM(m)	-etc.-	SO(m)	X(m/XB)	DIM1(m)	-etc.-
	DIMn(m)	NSM(m)	SO(B)	1	DIM1(B)	DIM2(B)	-etc.-	DIMn(B)
	NSM(B)							

PBEND	PID	MID	A	I1	I2	J	RB	THETAB
	C1	C2	D1	D2	E1	E2	F1	F2
	K1	K2	NSM	RC	ZC	DELTAN		

PBMSECT	PID	MID	FORM					
	Data description for arbitrary section							

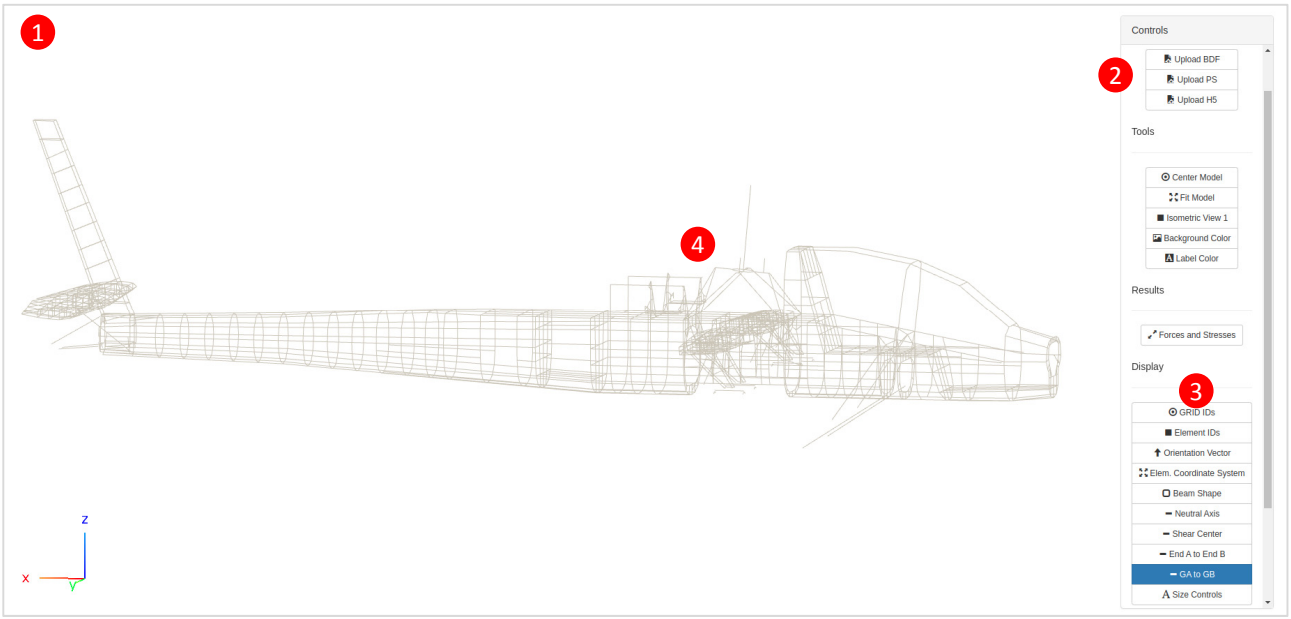
PBRSECT	PID	MID	FORM	NSM				
	Data description for arbitrary section							

PROD	PID	MID	A	J	C	NSM		

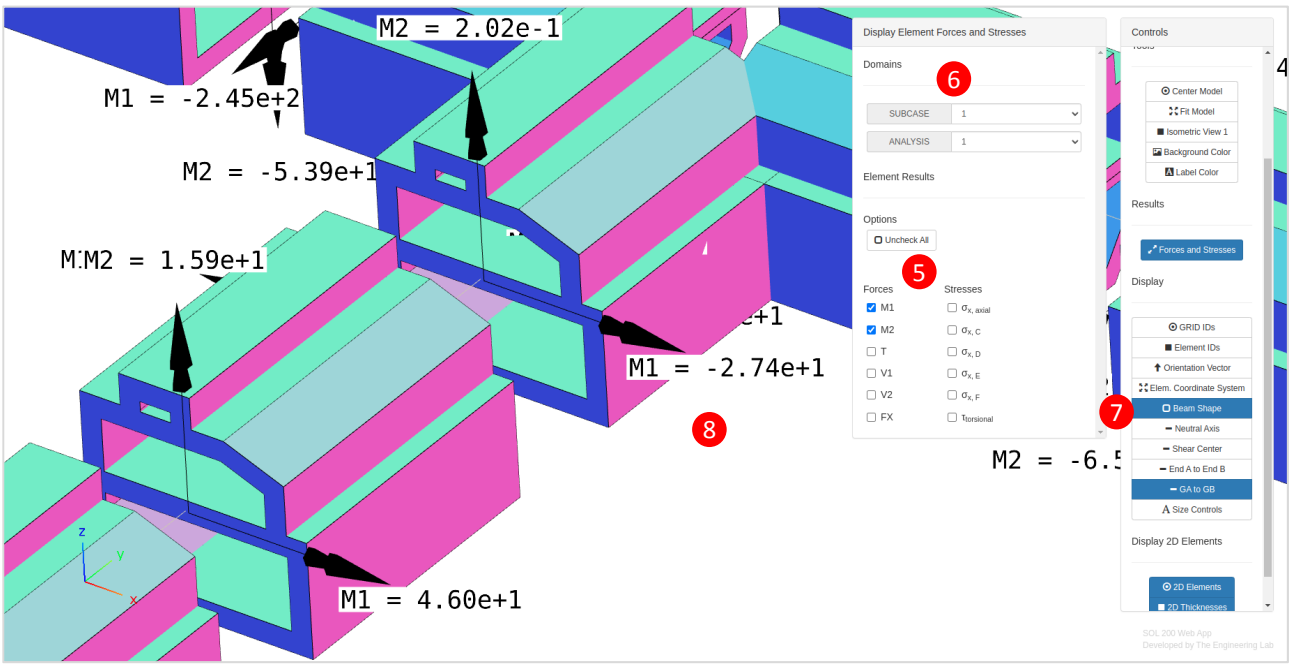
PTUBE	PID	MID	OD	T	NSM	OD2		

Workflow

1. Open a web browser to access the Beams Viewer
2. Upload BDF or H5 files
3. Control the display of GRID IDs, element IDs, orientation vector, etc.
4. View the respective line elements

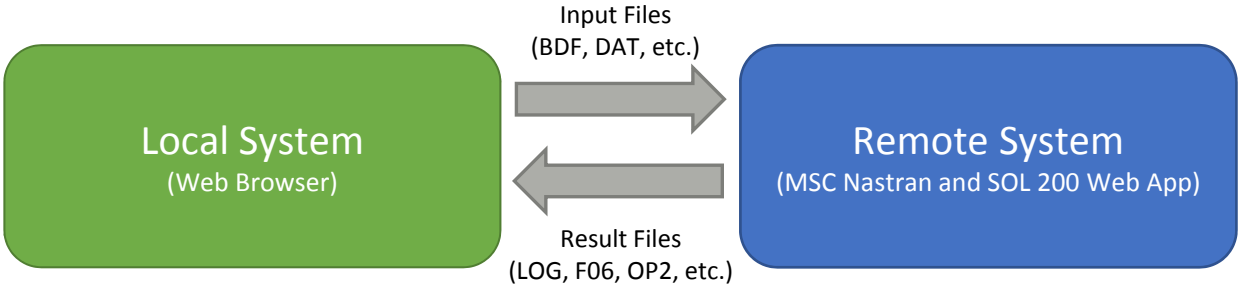


5. Display internal element forces such as moments, shear forces, torque and axial forces
6. Switch between different subcases, time steps, forcing frequencies, etc.
7. Display the cross section of the 1D elements
8. View the internal element forces displayed on the cross sections



Remote Execution

The Remote Execution web app allows users to run MSC Nastran on remote operating systems available on the local network. Traditionally, an FTP and SSH program are used to copy files to the remote system and start the MSC Nastran program. The Remote Execution web app allows for the same workflow but with only a web browser. Use the Remote Execution web app to upload BDF files to the remote system and start the MSC Nastran program.

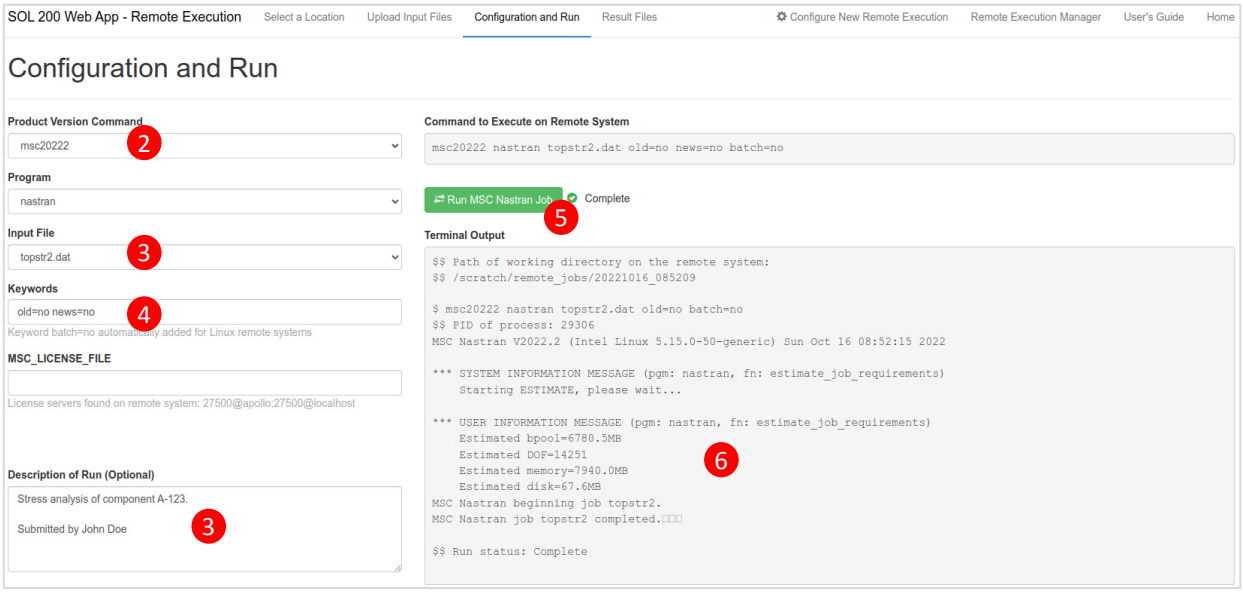


Capabilities

- Supported operating systems: Windows and Red Hat Linux
- Support for regular MSC Nastran jobs and MultiOpt
- View live changes to the LOG, F04 and F06 files during the MSC Nastran run
- Download result files from the remote system to the local system
- Manage jobs on the remote system by using the Remote Execution Manager
- No FTP or SSH required
- MSC Nastran and the SOL 200 Web App must be installed together on the same remote operating system

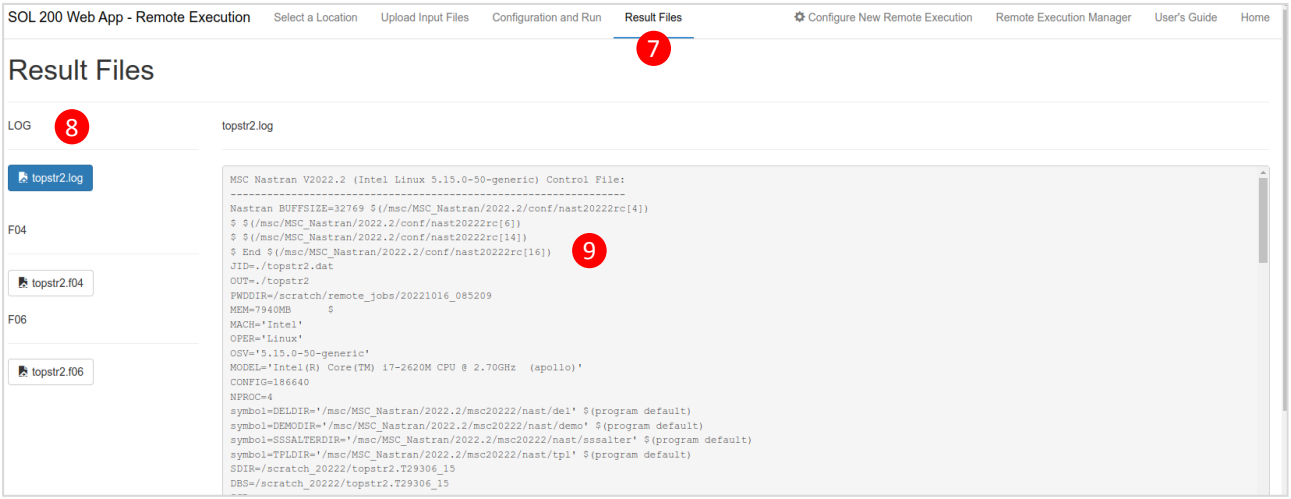
Workflow

1. Open a web browser, navigate to the Remote Execution web app and upload BDF files (Not shown)
2. Select an MSC Nastran version to use for the job
3. Select the BDF, DAT or other input file to run
4. Specify any keywords to use during the MSC Nastran job
5. Click Start SMC Nastran Job
6. Watch live output of the remote terminal



Workflow

7. Navigate to the Result Files section
8. Switch between any LOG, F04 or F06 file generated during the MSC Nastran job
9. View live output of the result files. Any update to the file on the remote system is also updated in the web browser.



10. Click the Download link to download result files from the remote system. Result files include LOG, F06, OP2, etc.
11. Click Toggle Checkboxes to select all the files
12. Select files of your own choosing by marking the checkboxes
13. Click Download Selected Files to download the result files from the remote system
14. Access the Remote Execution Manager page to access other jobs on the remote system, stop currently running jobs, or remove unnecessary jobs from the remote system