




Webinar:
**Checking Element Quality in
Simcenter 3D**


Jason O'Neal, ATA Engineering
December 11th, 2019

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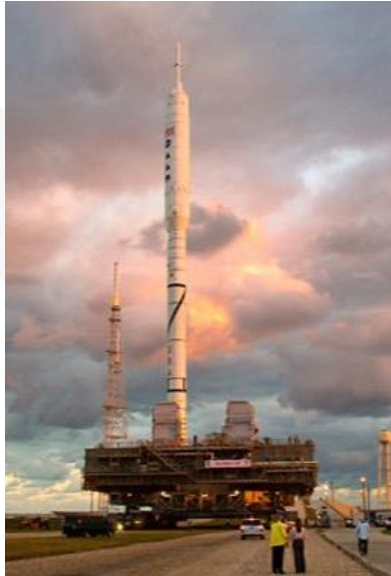
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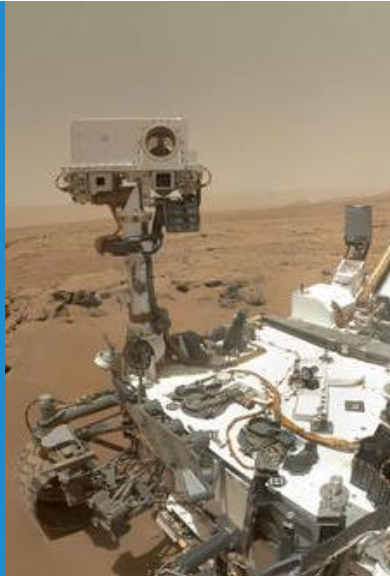
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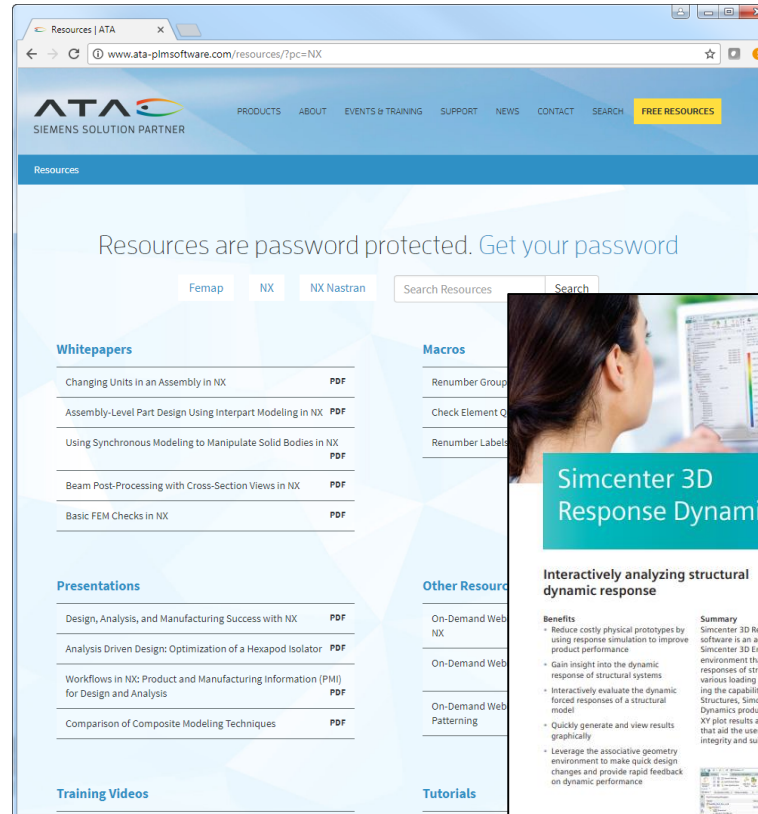
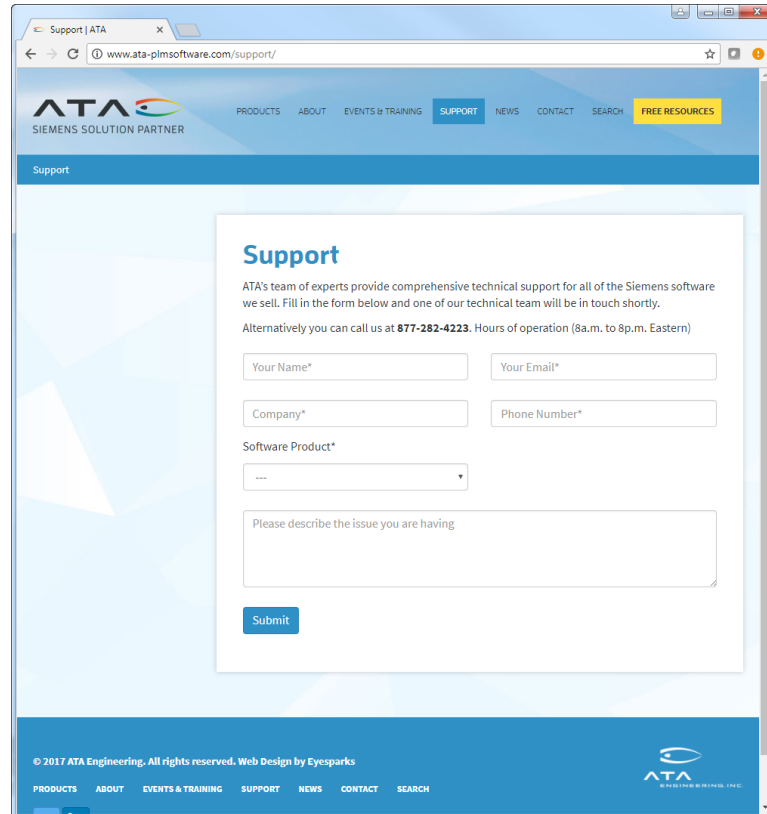
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Simcenter 3D Response Dynamics

designs subject to dynamic loads. Analysis information can then be used to perform design studies to enhance the new product development process and ensure the quality of designs prior to physical prototyping and production.

A flexible way to predict responses
Simcenter 3D Response Dynamics enables users to interactively evaluate the dynamic forced responses of a structural model. A set of flexible tools allows you to predict response of a model to a set of applied transient, frequency (harmonic), random vibratory or shock spectrum loads. A modal formulation is used to very efficiently calculate response using a prior solved set of mode shapes. The NX Nastran solver is used for solving mode shapes which are stored in a standard OP2 File format. Both normal modes and static modes for advanced methods are

Interactively analyzing structural dynamic response

Benefits

- Reduce costly physical prototypes by using response simulation to improve product performance
- Gain insight into the dynamic response of structural systems
- Interactively evaluate the dynamic forced responses of a structural model
- Quickly generate and view results graphically
- Leverage the associative geometry environment to make quick design changes and provide rapid feedback on dynamic performance

Summary
Simcenter 3D Response Dynamics software is an add-on module to the Simcenter 3D Engineering Desktop environment that predicts the dynamic responses of structural systems under various loading conditions. Augmenting the capabilities of Simcenter 3D Structures, Simcenter 3D Response Dynamics produces a broad range of XY plot results and color contour results that aid the user in determining the integrity and suitability of product

Calculate root mean square (RMS) stress results for each ply in a laminate composite structure.

www.siemens.com/plm/simcenter3d



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Outline

- This webinar will include:
 - How to identify poor-quality elements
 - Methods to improve these elements in Simcenter 3D
 - Live demo to illustrate some of the Simcenter tools available

How Does Element Quality Affect Analyses?

- Element quality is key for producing high-quality, accurate results and deliverables
- Finite element models inherently have error because they use discrete elements to represent continuum bodies
- Bad elements deviate considerably from equilateral shapes and further reduce model accuracy

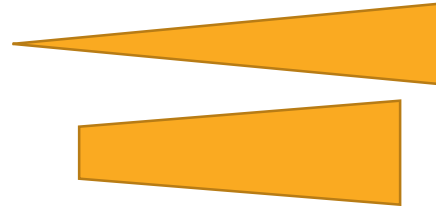
Poor Element Quality Comes in Different Forms

- Measures for quantifying element quality include:

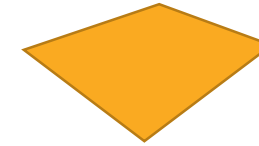
Aspect Ratio



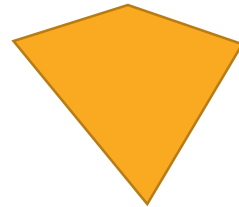
Taper



Element Warping
(out-of-plane deviation)



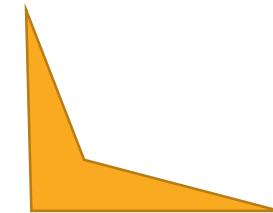
Interior Angles



Skew



Jacobian

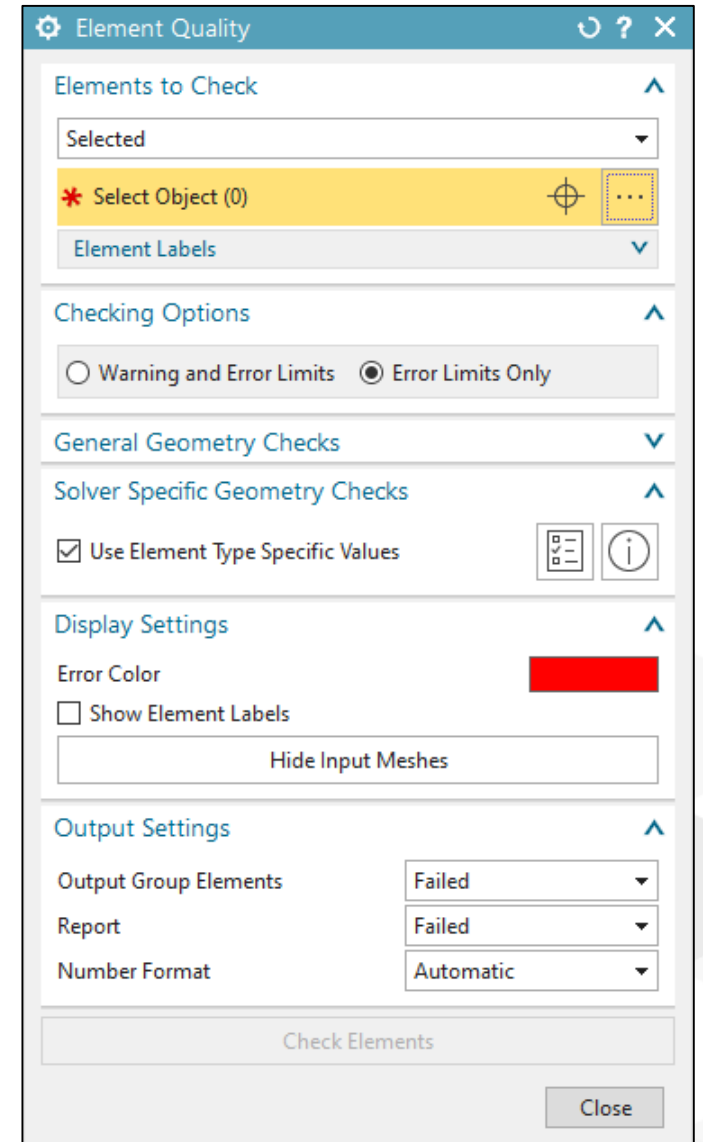


- Jacobian determinant:

- Negative values occur at node if corresponding interior angle is greater than 180°
- Solution will fail with negative determinant
- Examples:
 - When a triangle starts to flatten into a straight line
 - When a quad starts to look like a triangle

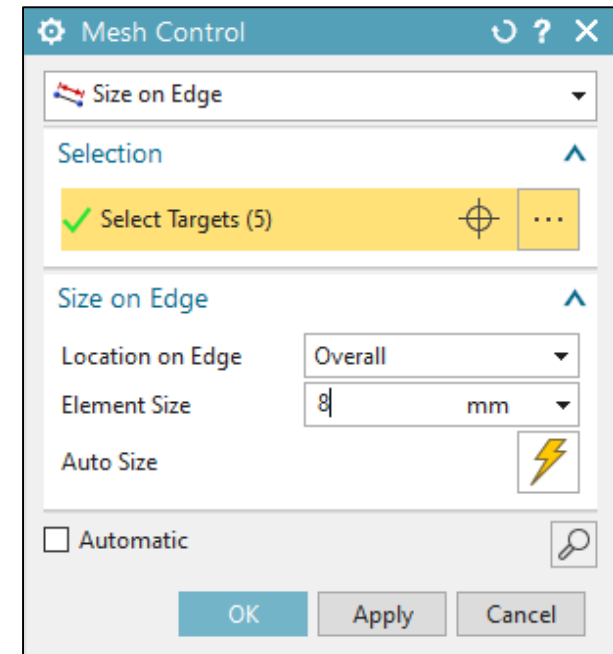
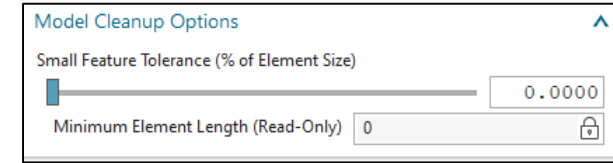
How to Check Element Quality in Simcenter 3D

- In the FEM, on the Home ribbon, click on More in the “Checks and Information” section and choose Element Quality under “Checks”
- Click on the pull-down under Elements to choose Displayed or Selected
- Under Checking Options, select between Warning and Error Limits or Error Limits Only
- Under Solver Specific Geometry Checks it is suggested to check the box for Use Element Type Specific Values
 - Default values can be changed, if needed
- Click Check Elements
- NX will print whether or not there are elements that failed the quality check, depending on the options selected in Output Settings
- Failed elements will be highlighted in the graphics window



Managing Element Quality in Simcenter 3D

- Below are some suggestions that can help improve element quality when creating a mesh.
- Avoid meshing very coarsely on small features as Simcenter can “smooth” over these features which can affect all future meshes unless the geometry is “reset” before the mesh is refined.
 - This can generally be avoided by setting the “Model Cleanup Options” in the mesh parameters to a low (or zero) value.
- For 3D elements, a good representation of element quality can be evaluated by checking the equivalent 2D mesh on the surface.
 - This can be done by applying a “Surface Coat” to a 3D element mesh.
- Generally speaking, having more control over a mesh can lead to better element quality, especially on complex geometry.
 - Mesh parameters, mesh controls, and “seed meshes” are good examples of controlled meshing techniques.



How to Check Element Quality in Nastran

This should be done **in addition** to checking quality in Simcenter 3D

- F06 file will list out poor quality elements

```

TOLERANCE LIMITS ARE: SA = 30.00, IA(MIN) = 30.00, IA(MAX) = 150.00, WF = 0.05, TR = 0.50, AR = 100.00
(XXXX = LIMIT VIOLATED)
ELEMENT TYPE      ID      SKEW ANGLE  MIN INT. ANGLE  MAX INT. ANGLE  WARPING FACTOR  TAPER RATIO  ASPECT RATIO
QUAD4             302104    76.84        54.56           118.99           0.00           0.53 XXXXX    1.98
QUAD4             302252    69.59        47.02           115.35           0.00           0.55 XXXXX    2.29
QUAD4             302253    78.66        55.82           122.06           0.00           0.55 XXXXX    1.92
QUAD4             302255    83.86        60.56           124.48           0.00           0.53 XXXXX    1.92
QUAD4             302256    71.23        47.73           120.93           0.00           0.59 XXXXX    2.30
QUAD4             302258    83.25        60.08           124.90           0.00           0.54 XXXXX    1.81
QUAD4             302260    70.83        47.88           120.48           0.00           0.59 XXXXX    2.23
QUAD4             302277    75.82        51.29           124.96           0.00           0.59 XXXXX    2.20
QUAD4             302279    84.12        60.21           127.33           0.00           0.55 XXXXX    1.86
  
```

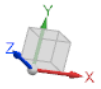
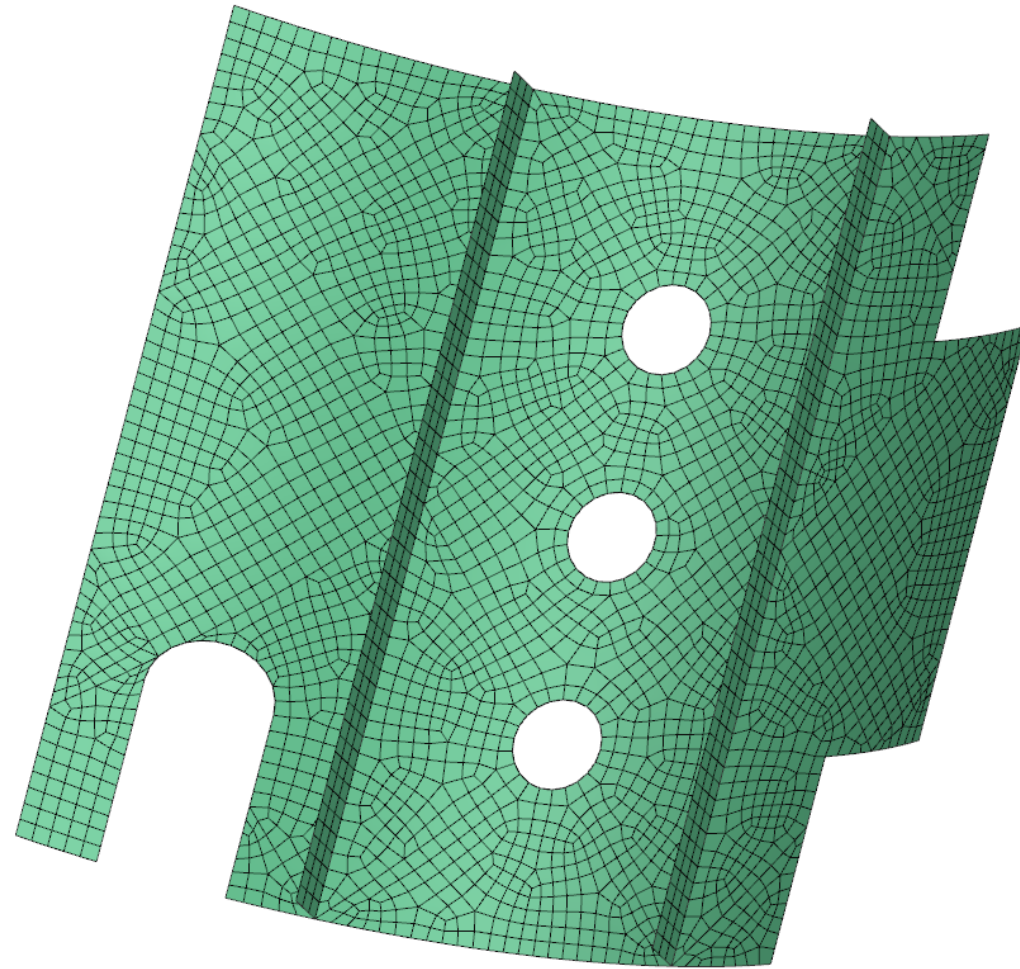
'xxxx' indicates an element warning; 'FAIL' is printed for elements that fail the NASTRAN element quality check

- Nastran will sometimes flag elements that didn't get flagged by pre-processor element quality checks
- What if the .f06 file didn't print out all the bad elements? In case control, add this line:
 - GEOMCHECK MSGLIMIT = 5000

What to do About Poor Quality Elements

- In general, it is worth spending time fixing bad elements
- In some cases, it may be ok to leave the model as is
 - If the bad elements are in a region where you are not interested in stress results
 - If there are just a few bad elements scattered across the mesh
- Make a group of elements with poor quality. Visually investigating them can give you an idea of where the problem area is and give you suggestions for how to improve the mesh.
- Things to Try:
 - Changing the element size
 - Free vs. mapped meshes
 - Adding geometric partitions
 - Add mesh constraints
 - Manually move nodes or adjust elements
 - For a larger model, check quality of separate meshes before connecting them together

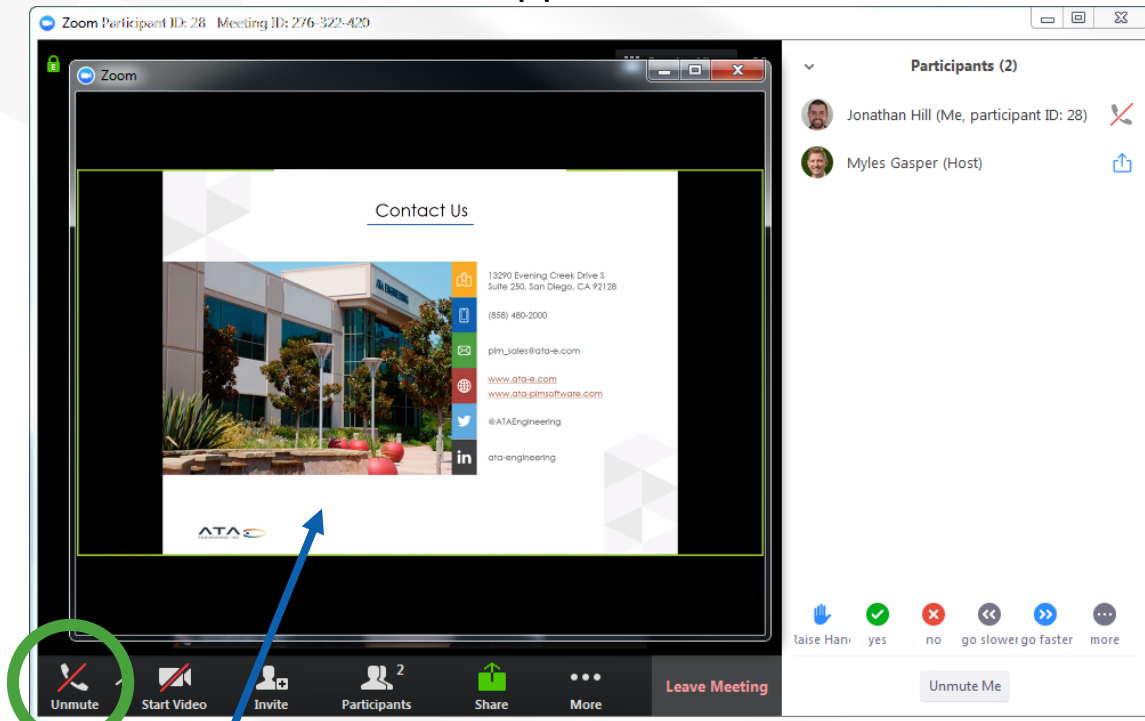
NX Demo



Questions?

Submit questions in the **chat** or **unmute yourself** now

Zoom Application

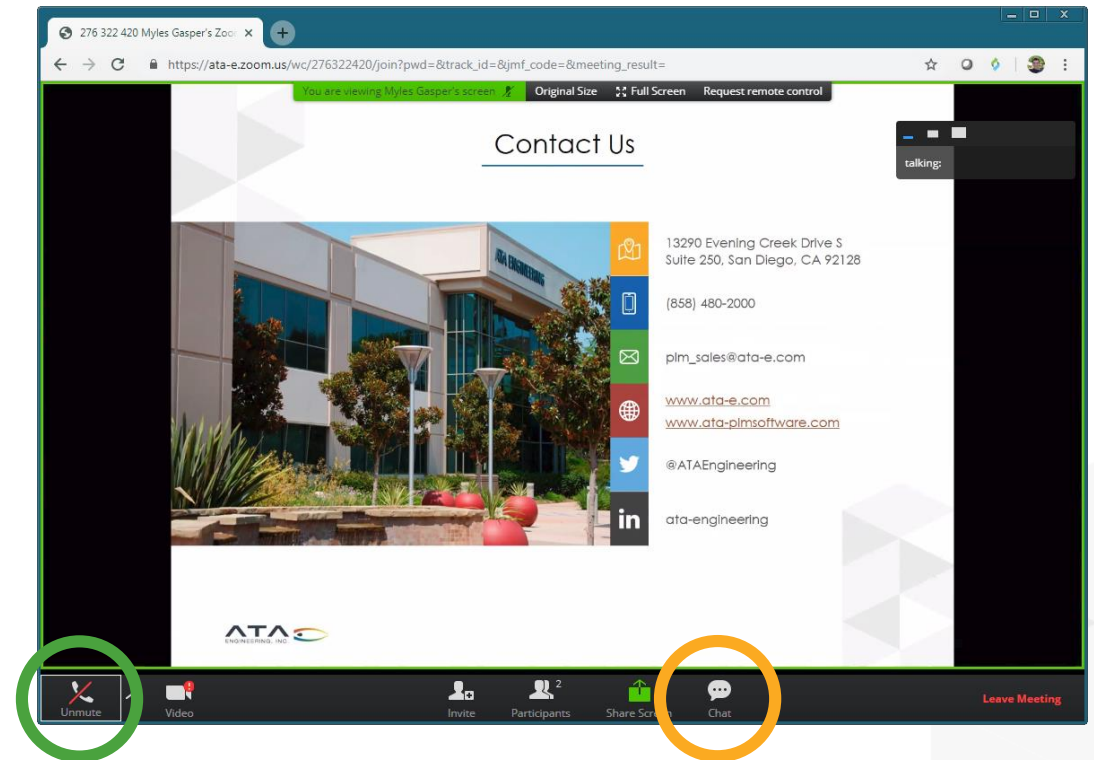


Screenshare in separate window

Chat is available under More



Web Interface



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