T015: DPLEN Substepping Criteria in 3D

Introduction

This document describes the most common substepping criteria (DPLEN) that is used when running 3D simulations in DEFORM.

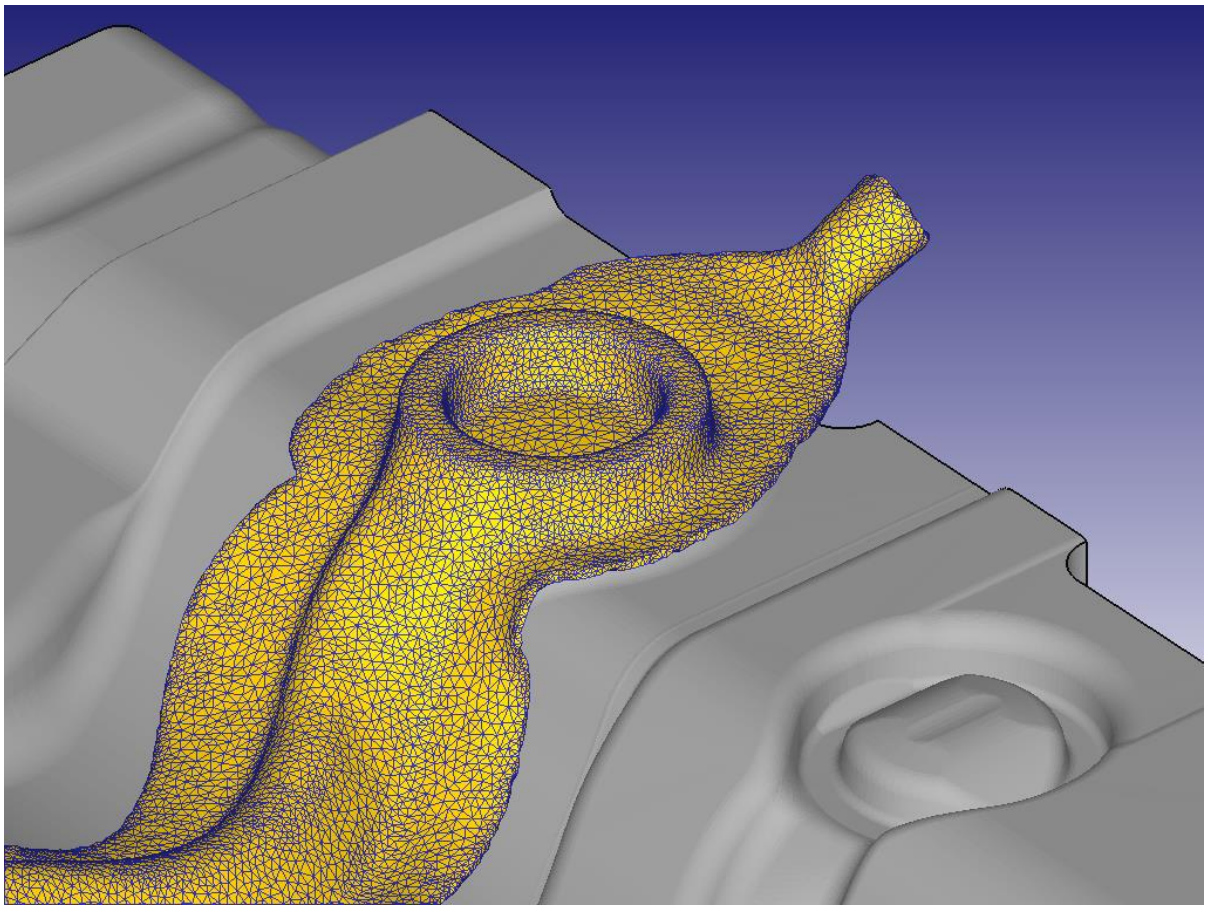
Problem Description

DEFORM simulations are divided into many time steps, where the deformation in each step is relatively small. The deformation at each step is kept small so that the solution at each step will be more accurate. If the step size is too large, DEFORM has a substepping criteria that will activate, dividing the large step into several smaller steps. This substepping process retains the accuracy of the simulation.

This substepping criteria is called maximum polygon length substepping, or DPLEN. This document should help improve the understanding of how this substepping criteria works.

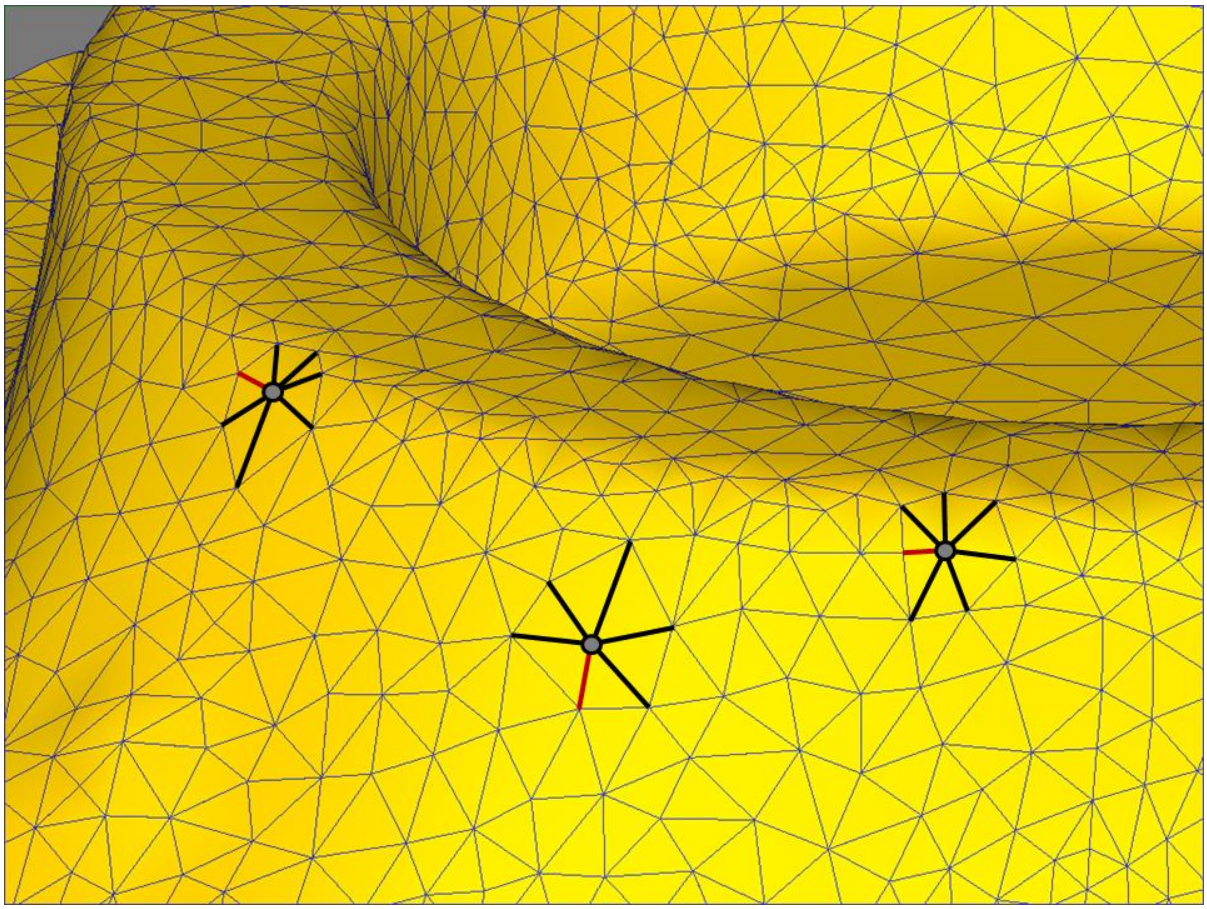
Background Information

A typical forging simulation is shown below. The default meshing parameters were used so that small elements were placed in the most critical regions.



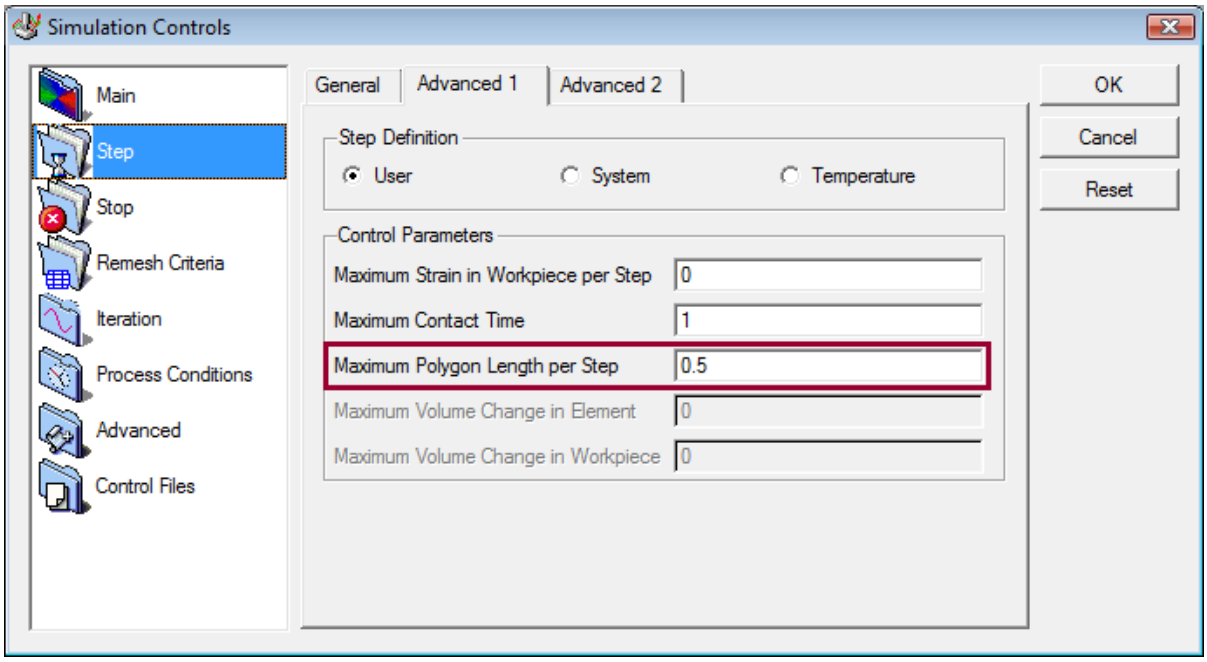
For this forging simulation, what would a good step size be? This general rule of thumb is that the maximum displacement for any node should not exceed about 1/3 the length of the shortest attached element edge length in one step.

This is illustrated in the below image. Each node in the workpiece (3 are highlighted) should not move more than about 1/3 of the length of the shortest attached element edge (shown in red). If the steps were set so that the punch moved this distance per step (approximately 1/3 of short element edge length), that would be a good step size.



Solution

The maximum polygon length per step (DPLEN) substepping criteria is found in the Simulation Controls --> Step --> Advanced1 dialog.



The default value of 0.5 means that if any node tries to move 1/2 the distance of their shortest element edge length (red above) in any one step, the DPLEN substepping criteria will activate. When DPLEN gets activated, a comment will be added to the .MSG file.

```
*** INFO: Substepping due to DPLEN at Node    870 of Obj.  1
Old time step =  0.13626D-02; New time step =  0.99547D-03
```

This default setting works very well for almost all simulations run in DEFORM.

The one time when you might want to modify the DPLEN substepping behavior is when running rolling simulations, where the workpiece is rotating. In these type of simulations, as long as the rotating workpiece is only rotating a small amount per step (e.g. < 1º per step), then it is usually safe to deactivate DPLEN by setting it to 0.

Related Information

None