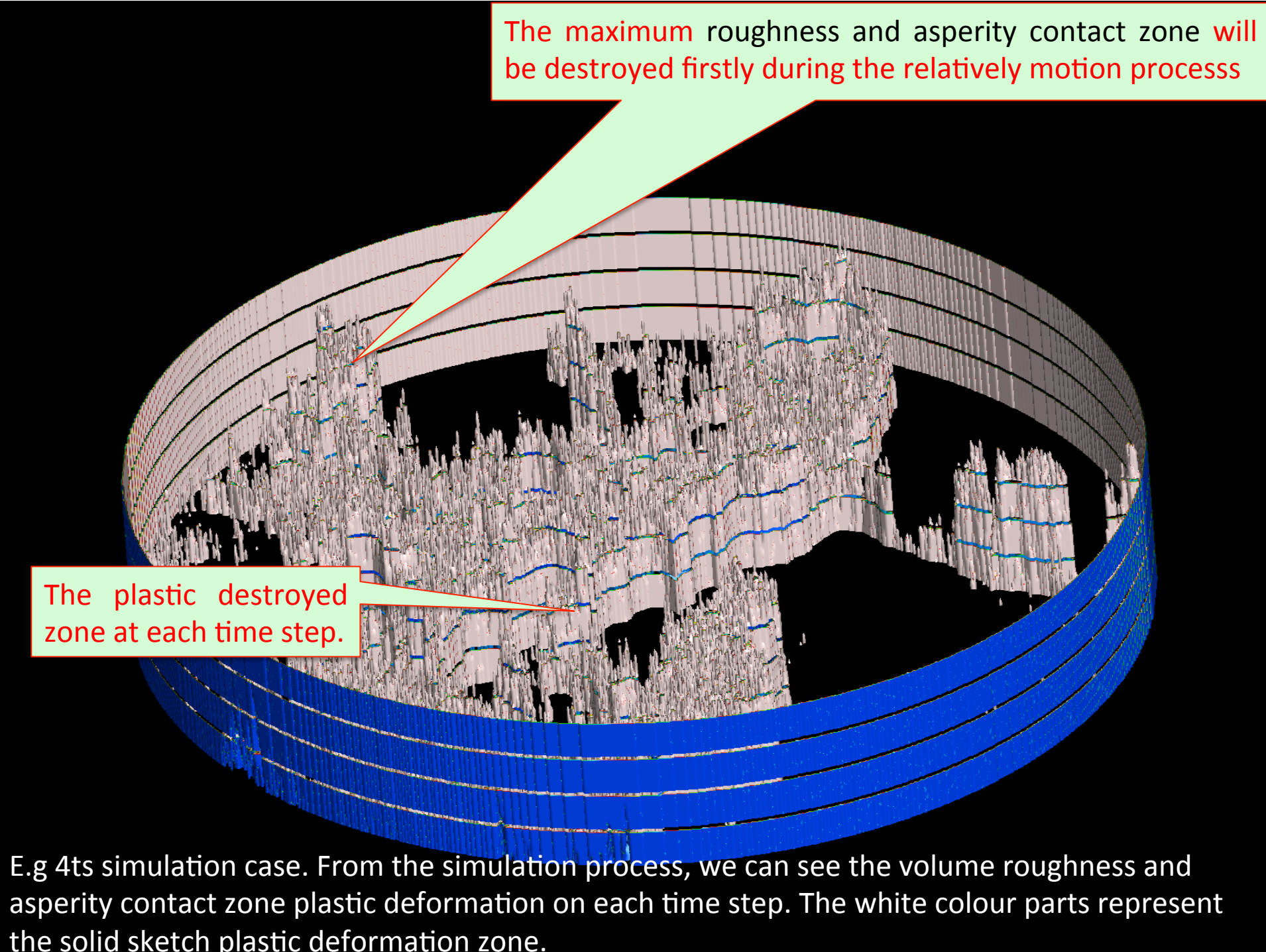


The friction and rheology virtual test for **volume roughness and asperity contact zone** relatively motion

Bojing Zhu

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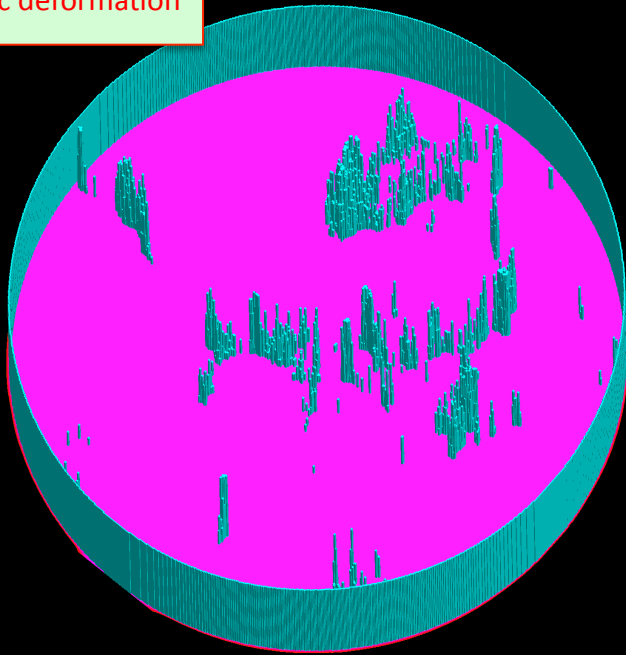
The maximum roughness and asperity contact zone will be destroyed firstly during the relatively motion process

The image shows a 3D simulation of a curved surface, possibly a gear or a similar mechanical part. The surface is rendered with a grid of lines, and the roughness is represented by a complex, multi-colored structure. The surface is divided into several horizontal bands. The top band is grey, the middle band is white, and the bottom band is blue. The white band is the most prominent and shows significant plastic deformation, with a rough, jagged surface. The blue band is smoother and appears to be the original surface. The grey band is also visible, showing some deformation. The overall structure is curved and appears to be part of a larger assembly.

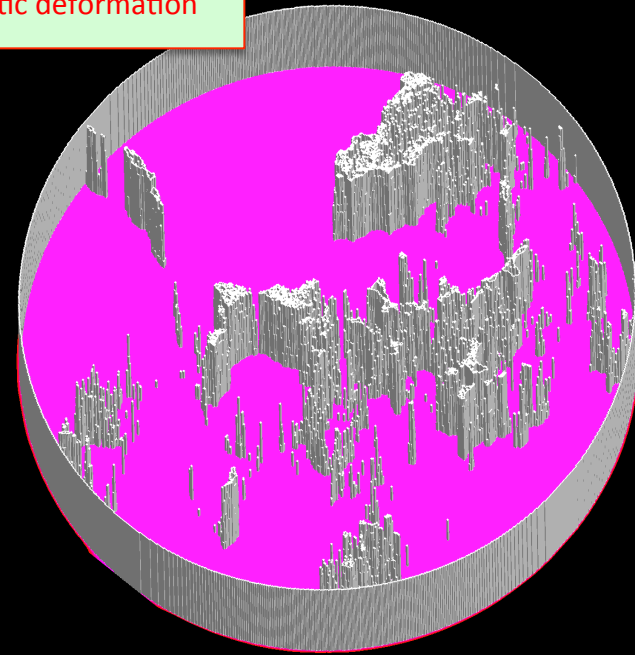
The plastic destroyed zone at each time step.

E.g 4ts simulation case. From the simulation process, we can see the volume roughness and asperity contact zone plastic deformation on each time step. The white colour parts represent the solid sketch plastic deformation zone.

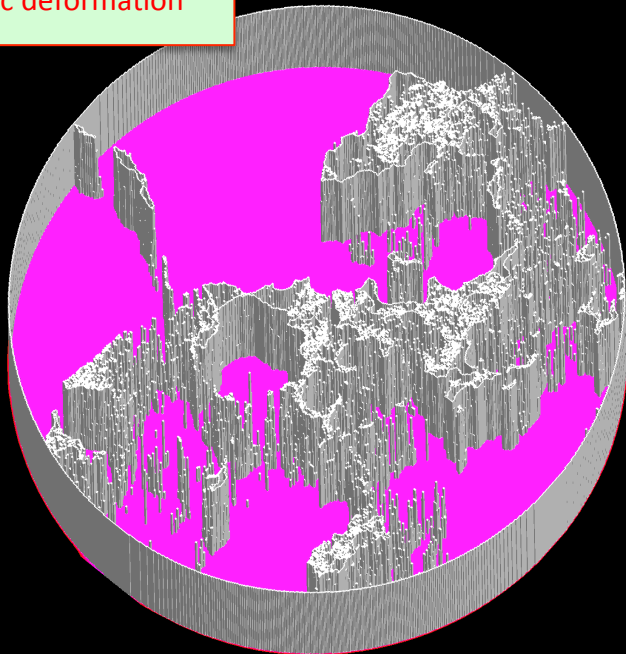
1<sup>st</sup> ts plastic deformation



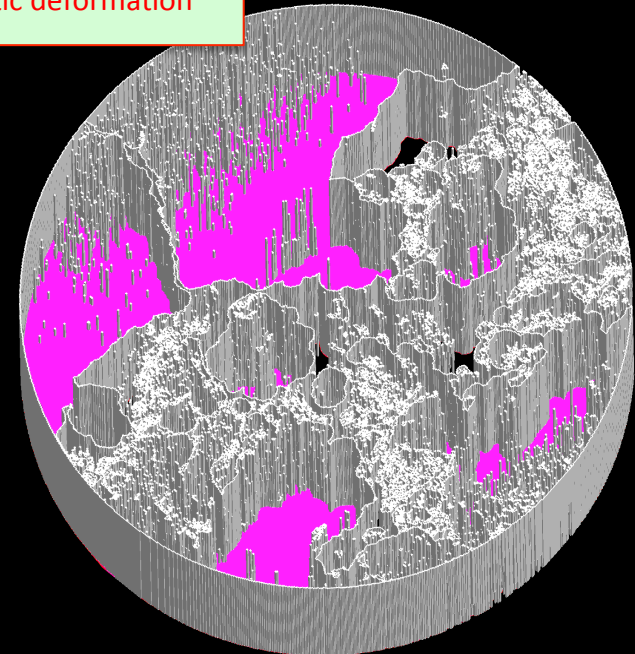
2<sup>nd</sup> ts plastic deformation



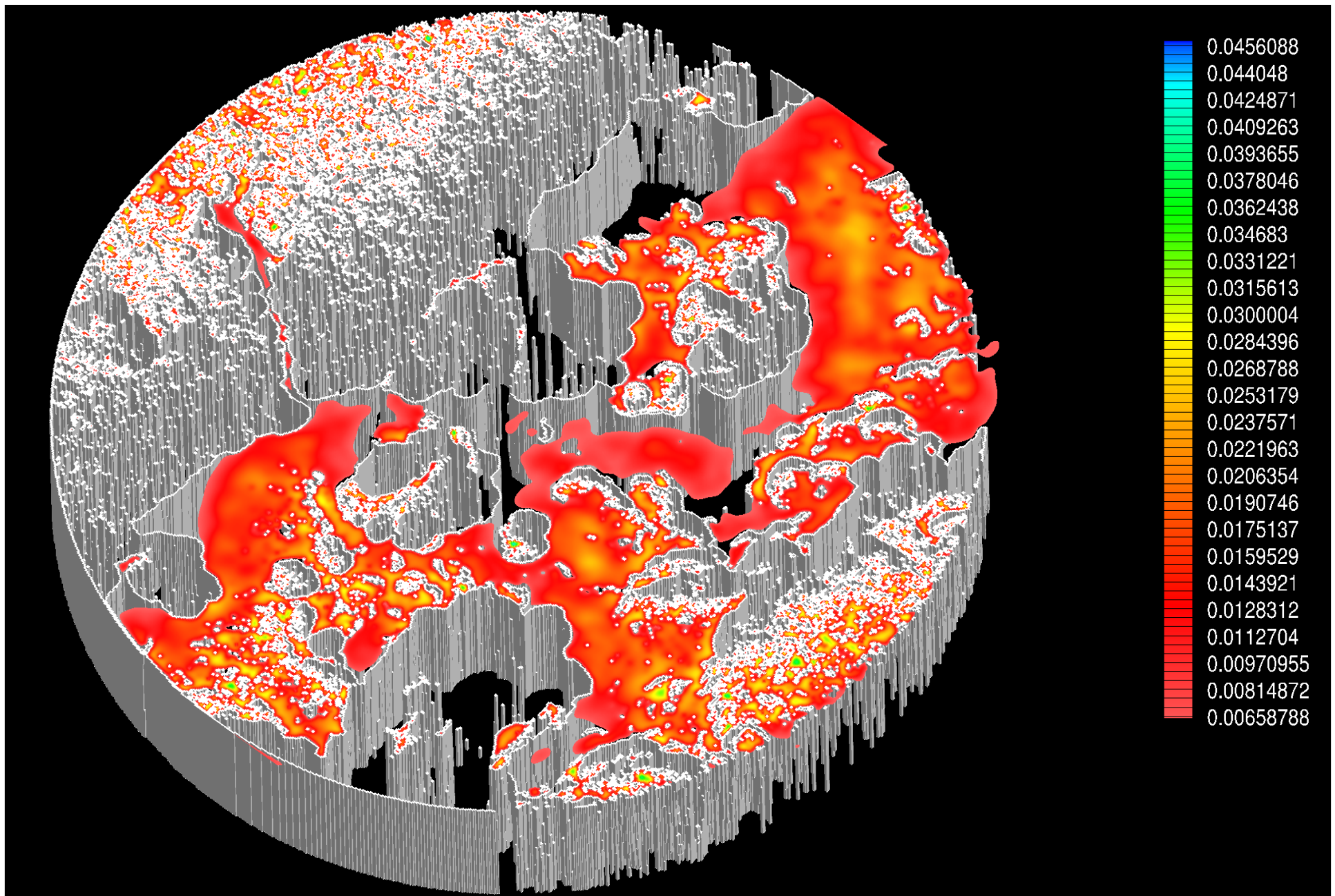
3<sup>rd</sup> ts plastic deformation



4<sup>th</sup> ts plastic deformation

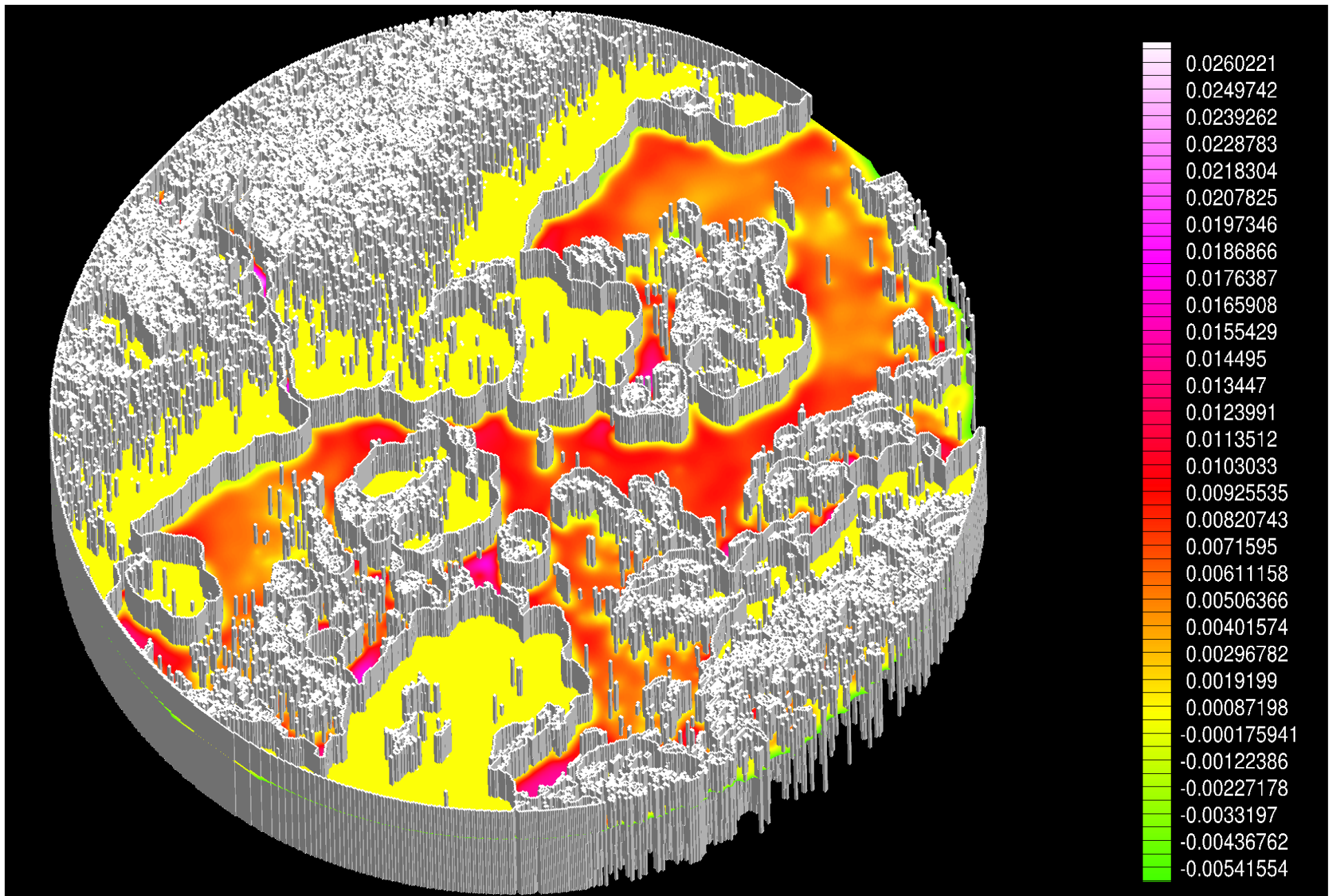




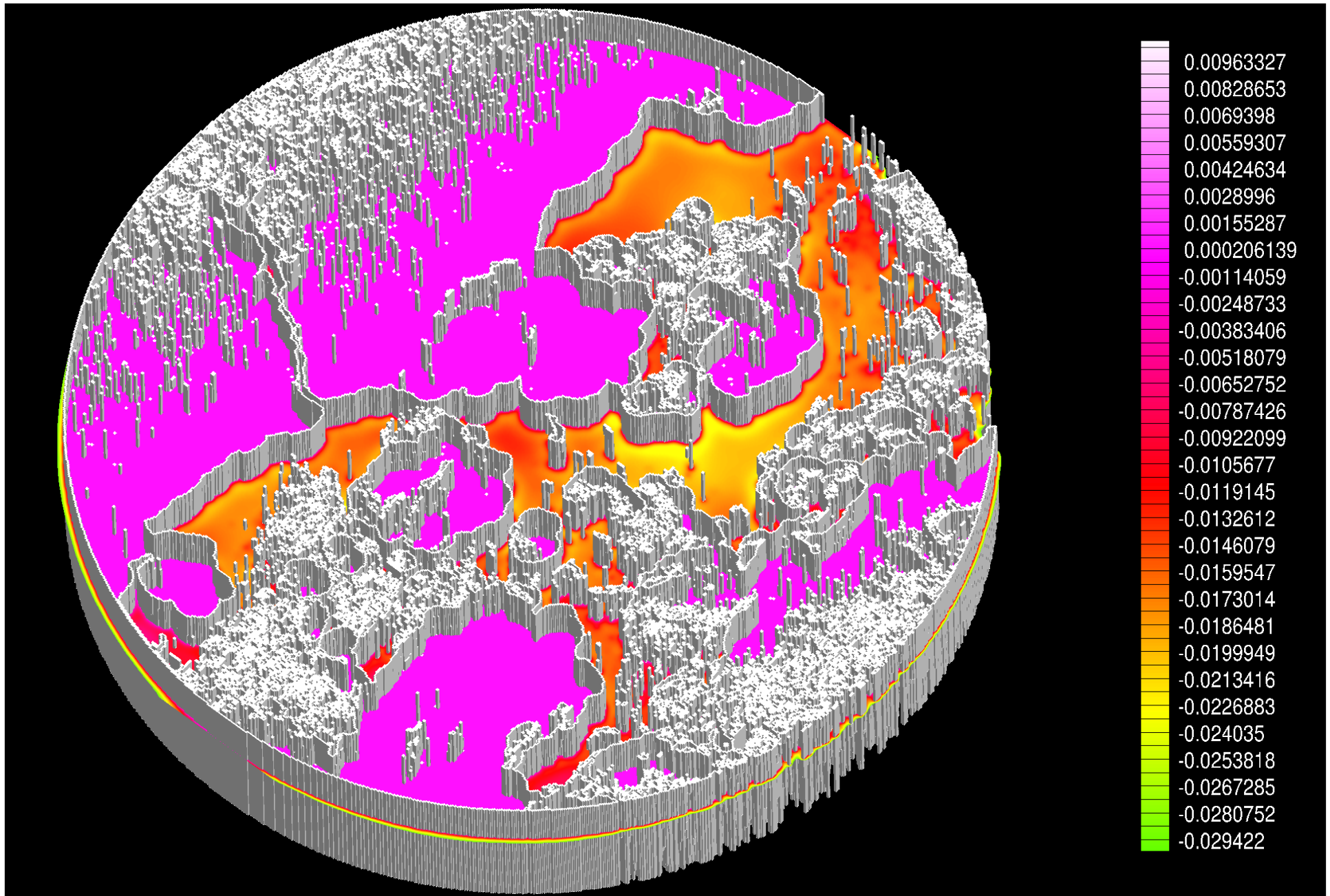


4 ts strain rate distribution as function of position in the volume roughness and asperity contact zone



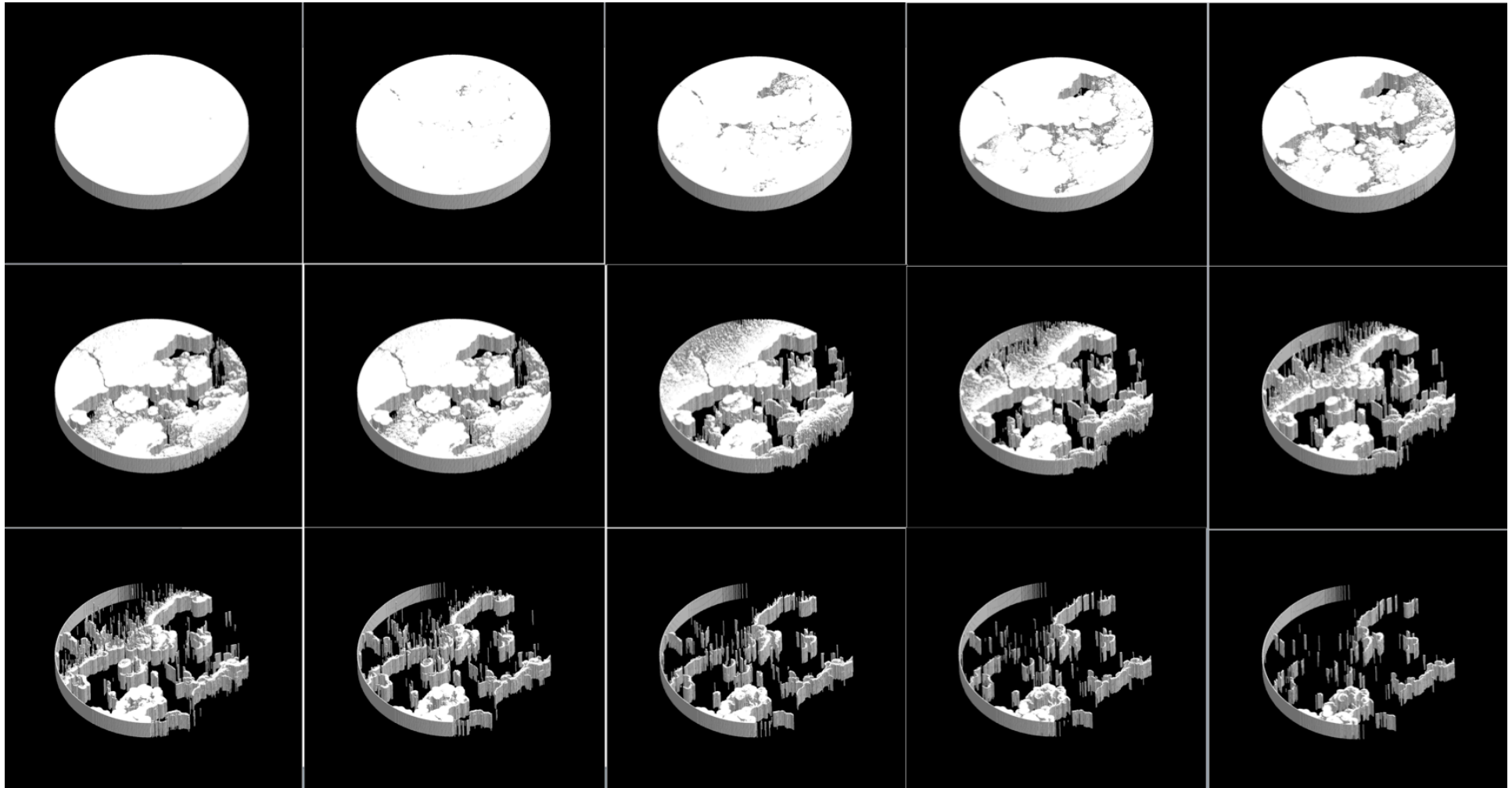


14 ts strain rate distribution as function of position in the volume roughness and asperity contact zone



24 ts strain rate distribution as function of position in the volume roughness and asperity contact zone

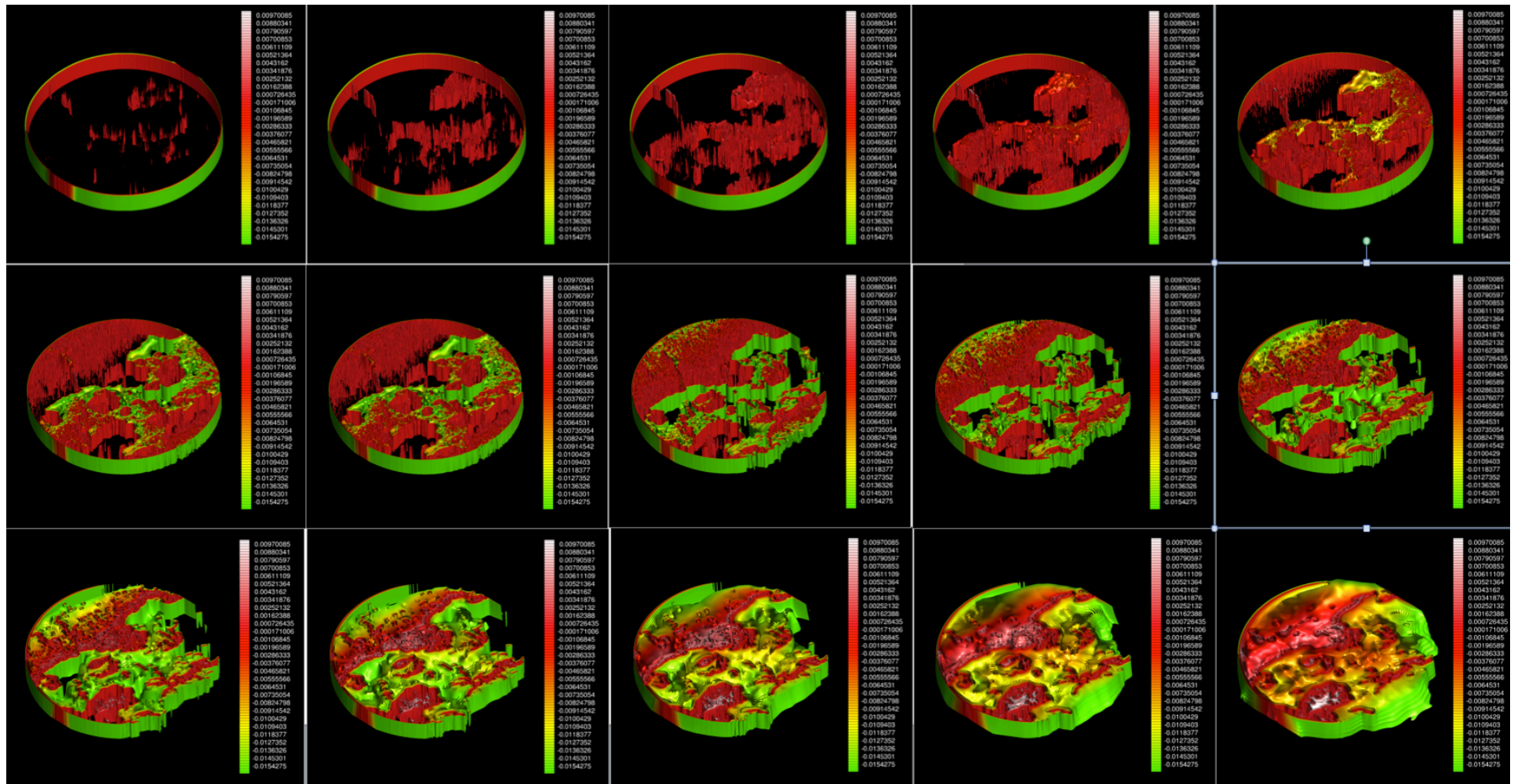
## Virtual test principle slip surface plastic-creep deformation process



During the relative motion late process, the solid-sketch asperity contact area is torn from the principle slip surface; the rheological properties play a leading role in the post-stage of flash heating process.

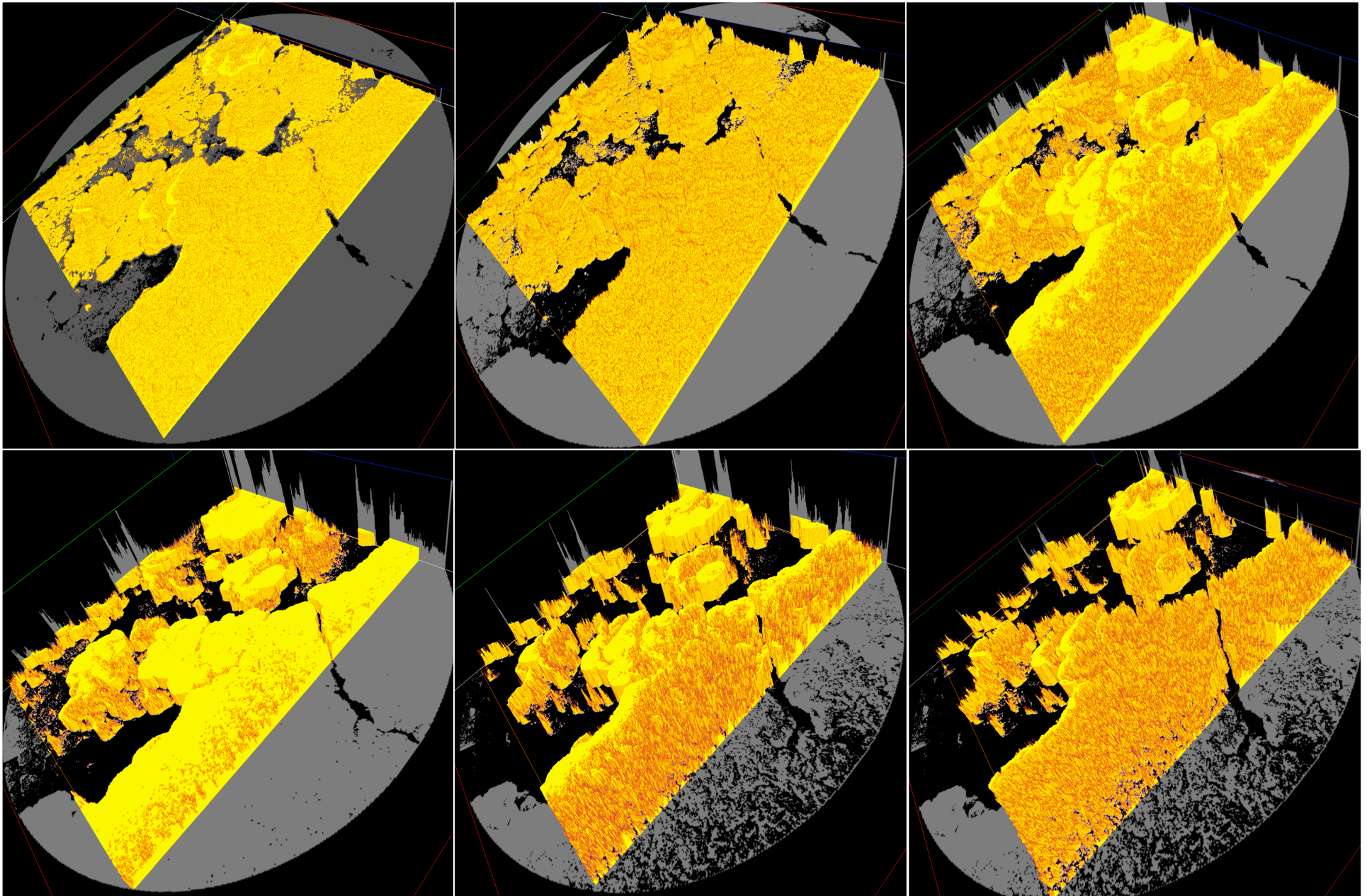


# Virtual test principle slip surface slip rate distribution as function of geometry structure



With the slip time increasing, the solid sketch zone (the volume roughness and asperity contact zone) on the principle slip surface is located on the visco-plasto-creep state (the friction heating)

# Virtual test rheological properties on the PSS during flash heating process





# Virtual test environments(3DLBM+HP cluster)

Model size: 759x640x185; parallel condition: 5920 core; parallel effective 59%

Data output start time: 11:32 Mar 30 2013

1<sup>st</sup> time step result output start time: 11:32 Mar 30 2013

2<sup>nd</sup> time step result output start time: 11:35 Mar 30 2013

4<sup>th</sup> time step result output start time: 11:42 Mar 30 2013

3<sup>rd</sup> time step result output start time: 11:39 Mar 30 2013

29<sup>th</sup> time step result output start time: 13:15 Mar 30 2013

```

PanActive Manager Critical Error: Hard Quota Violation
Data: Sat Mar 30 13:16:03 GMT 2013
System Name: panasas1.hpc.dur.ac.uk
System IP: 10.143.1.2 10.143.1.1 10.143.1.3
Version: 4.1.3-702504.9
Customer ID: 11111

Hard Quota Violation: Hard quota limit reached on volume /jgk78.
No further writes allowed in this volume.

The message applies to the following component:
Volume: /jgk78

The is no space on the hamilton for 30th time step result output, this is why we want apply 250GB space on the hamilton at beginning.
    
```

Before our job running, there are 670 free nodes

After our job running, there are 485 free nodes.

Our job starting time: 11:31:55 March 30

Our job using nodes: 185

Comment: One time step results size is equal to 32MB/node x 185 = 6 GB, this 2D case is 30 time step which means the total results size is 6 GBx30 = 180 GB (This can explain why we need around 200 GB capacity on cluster).

Our present case is 759x648x185 is a quasi-2D model, can describe the 3nm resolution(SEM 300nm/100px) in the low micro scale and 0.5um size in the macro scale.

Our final model is 3D model (for 4D model, 3 for the geometry and 1 for the physical/different phase), can describe the 0.3~0.2nm resolution (SEM 30~20nm/100px) in the lowest micro scale and 1~5 mm size in the macro scale(This can explain why we need 64GB+32GB memory Machines)

```

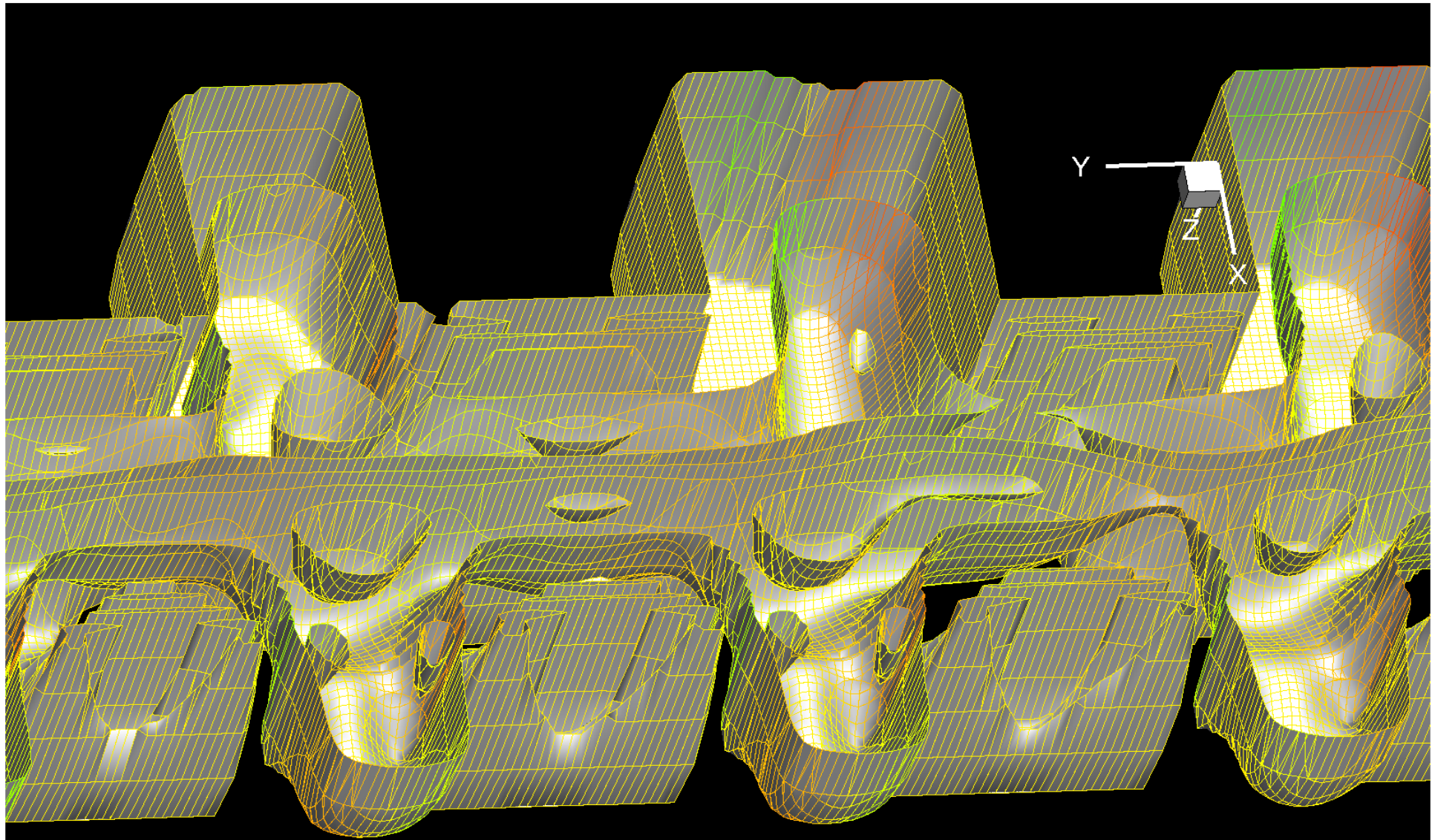
[jgk78@hamilton0 ~]$ qfrees
QUEUE PE(*) Used for/by FREE USED TOTAL
par.q orte e.g. MPI jobs(!) 402 1326 1368
seq.q - serial jobs(!) 7 1 8
openmp.q openmp shared memory(!)(%) 0 0 0
test.q any PE time limited(+) 48 0 48
qrsh.q any PE interactive use(x) 15 57 72
par5.q orte5 e.g. MPI jobs(ham5)(!) 49 855 904
openmp5.q openmp5 shared memory(ham5)(%) 288 20 308
seq5.q - serial jobs(ham5) 32 176 208

(+) PE=Parallel Environment, to submit to QUEUE with PE enter
qsub -q QUEUE -pe PE NSLOTS user_job_script
(!) Time limited to wall clock time of 72 hours
(+) Currently set to 00:20:00 (hh:mm:ss)
(x) In a login terminal enter the command qrsh (up to 4 per user)
(%) Maximum of 4 slots per shared memory job

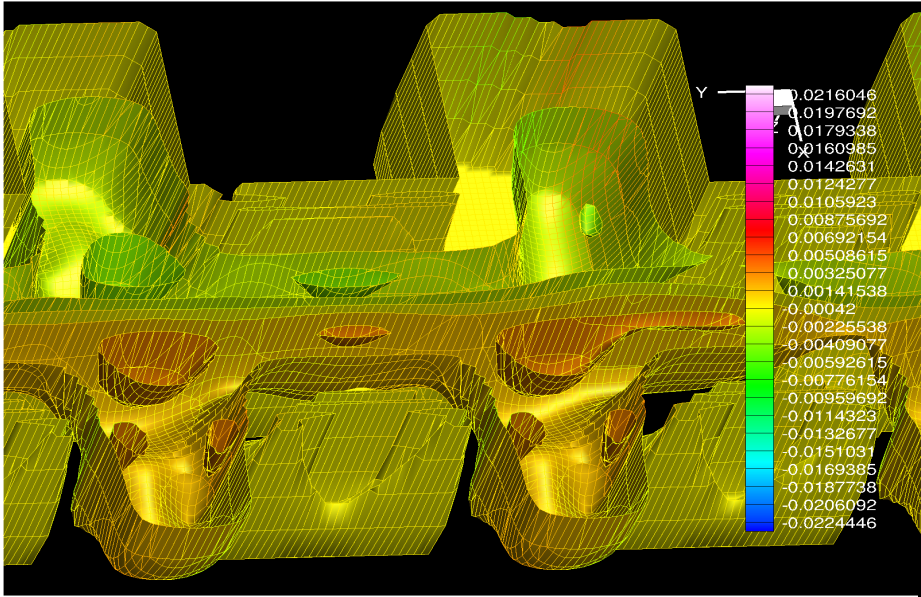
Module: To display what environment a <module> sets enter:
Module: module show <module>

Info: http://www.dur.ac.uk/~cis/local/hpc/hamilton
251526 0.54616 zpar5.csh jgk78 r 04/11/2013 13:59:47 par5.q@cn445.hpc.dur.ac.uk 185
jgk78@hamilton0 ~$ qstat
ob-ID prior name user state submit/start at queue slots ja-tas
-----
251526 0.54616 zpar5.csh jgk78 r 04/11/2013 13:59:47 par5.q@cn445.hpc.dur.ac.uk 185
jgk78@hamilton0 ~$ qstat
ob-ID prior name user state submit/start at queue slots ja-tas
-----
251526 0.54616 zpar5.csh jgk78 r 04/11/2013 13:59:47 par5.q@cn445.hpc.dur.ac.uk 185
jgk78@hamilton0 ~$ qstat
ob-ID prior name user state submit/start at queue slots ja-tas
-----
251526 0.54616 zpar5.csh jgk78 r 04/11/2013 13:59:47 par5.q@cn445.hpc.dur.ac.uk 185
    
```





3DLBM girds for one temporal-spatial point rheological properties (strain rate)  
(759x640x185)



Strain rate contour

Rheological strain rate tensor

