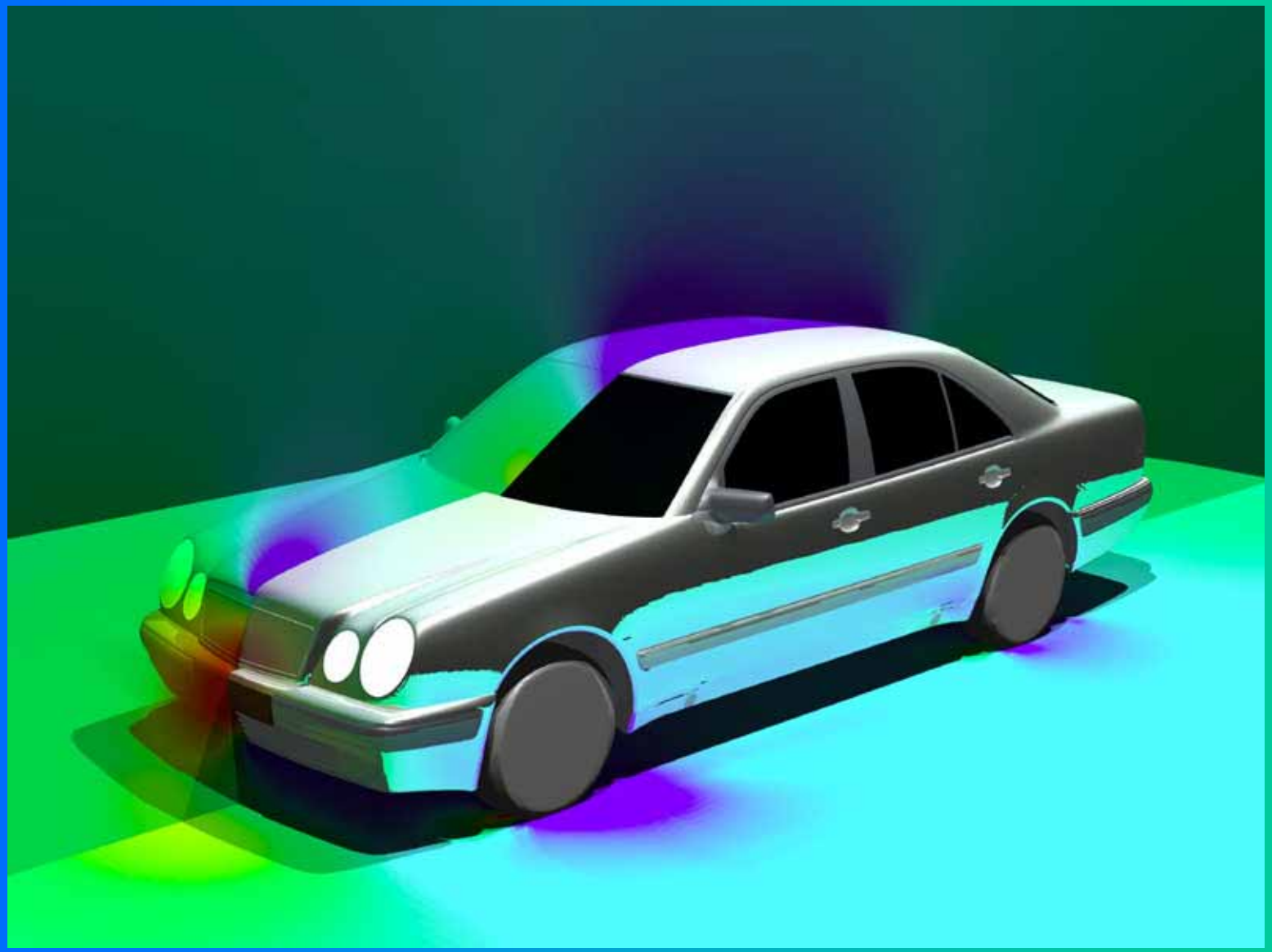
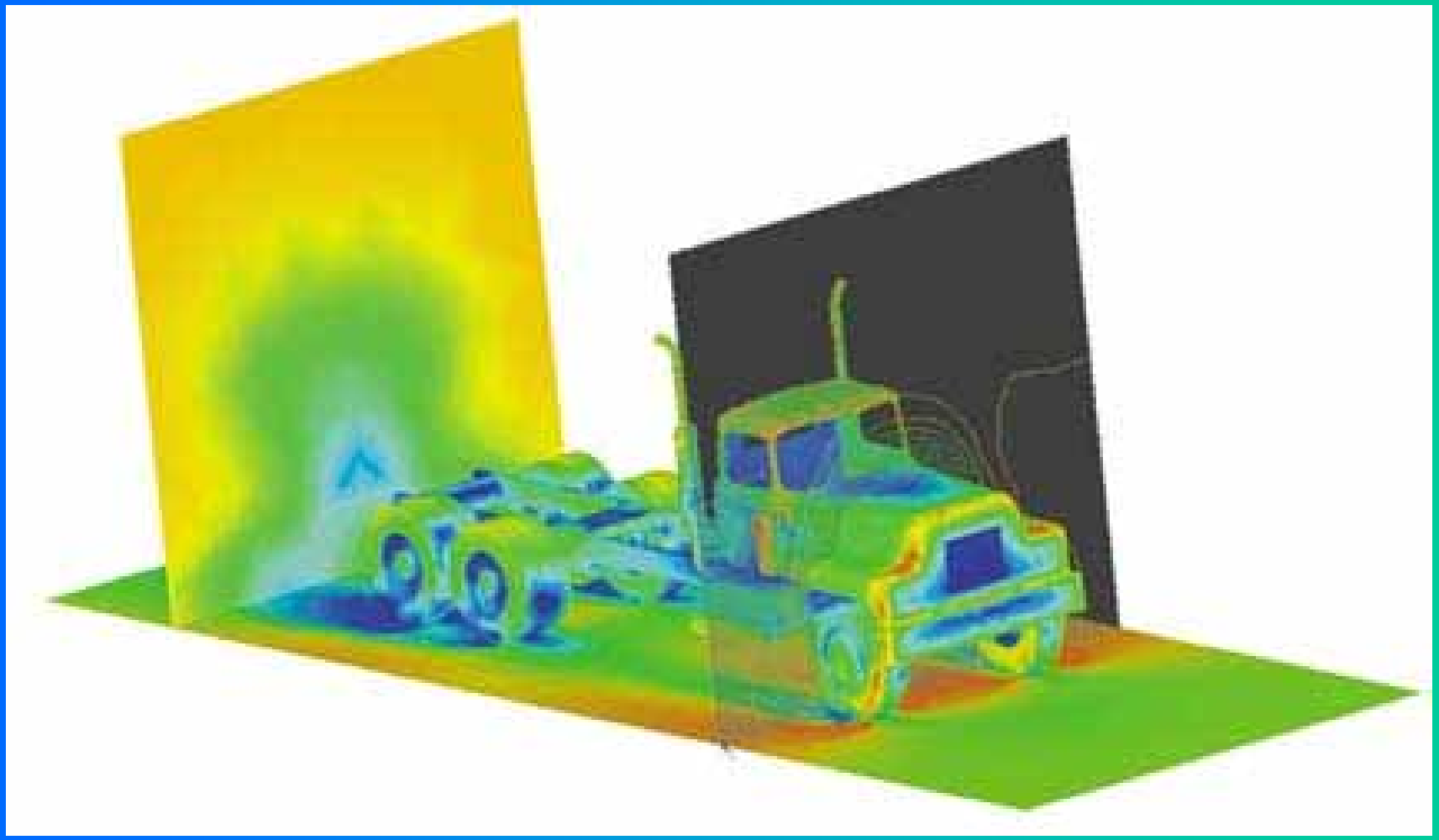
STAR-CD在汽车空气动力学中的应用

主要应用领域

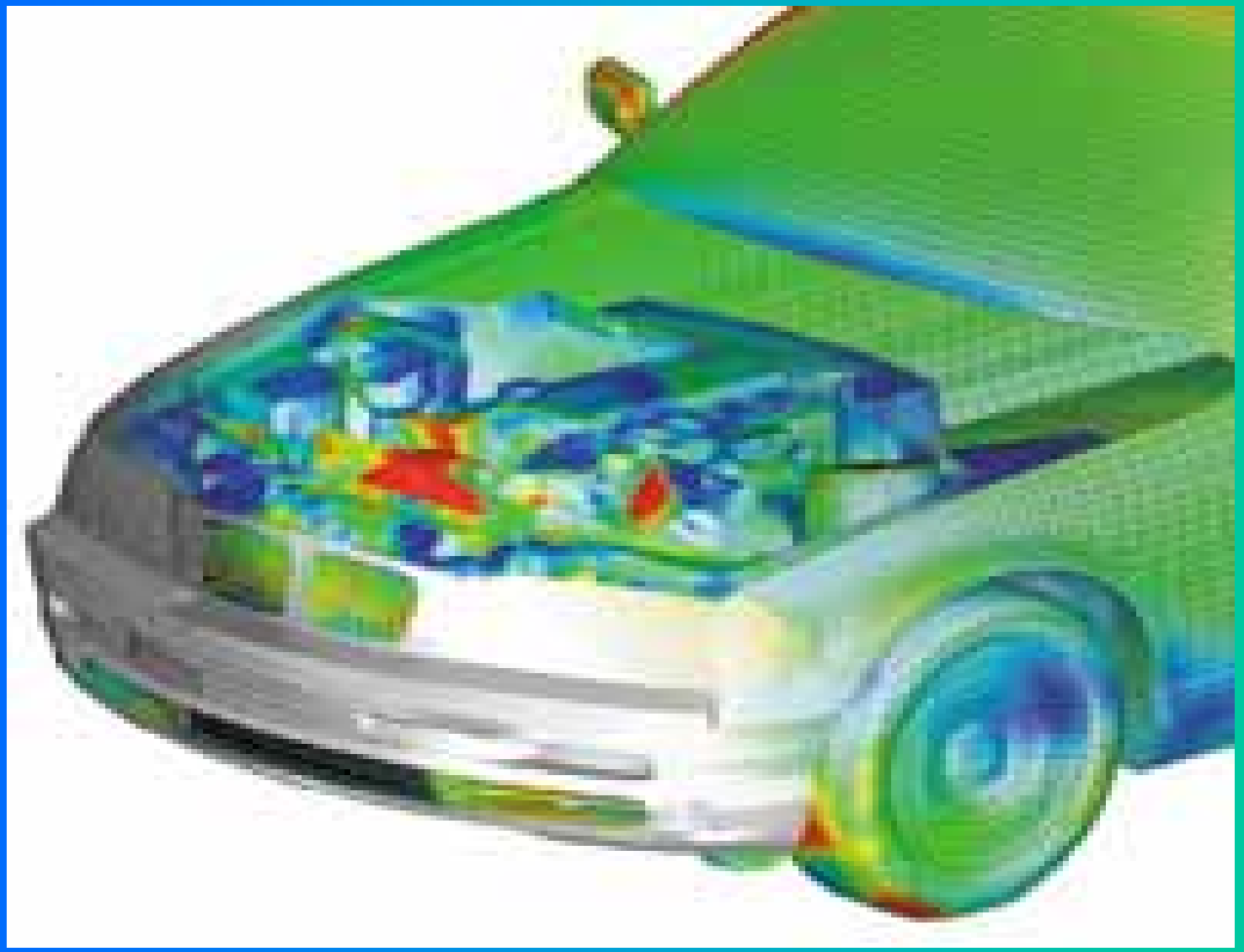
- 汽车外流流场分析
- 汽车内流流场分析
- 发动机系统和部件设计
- 汽车尾气排放



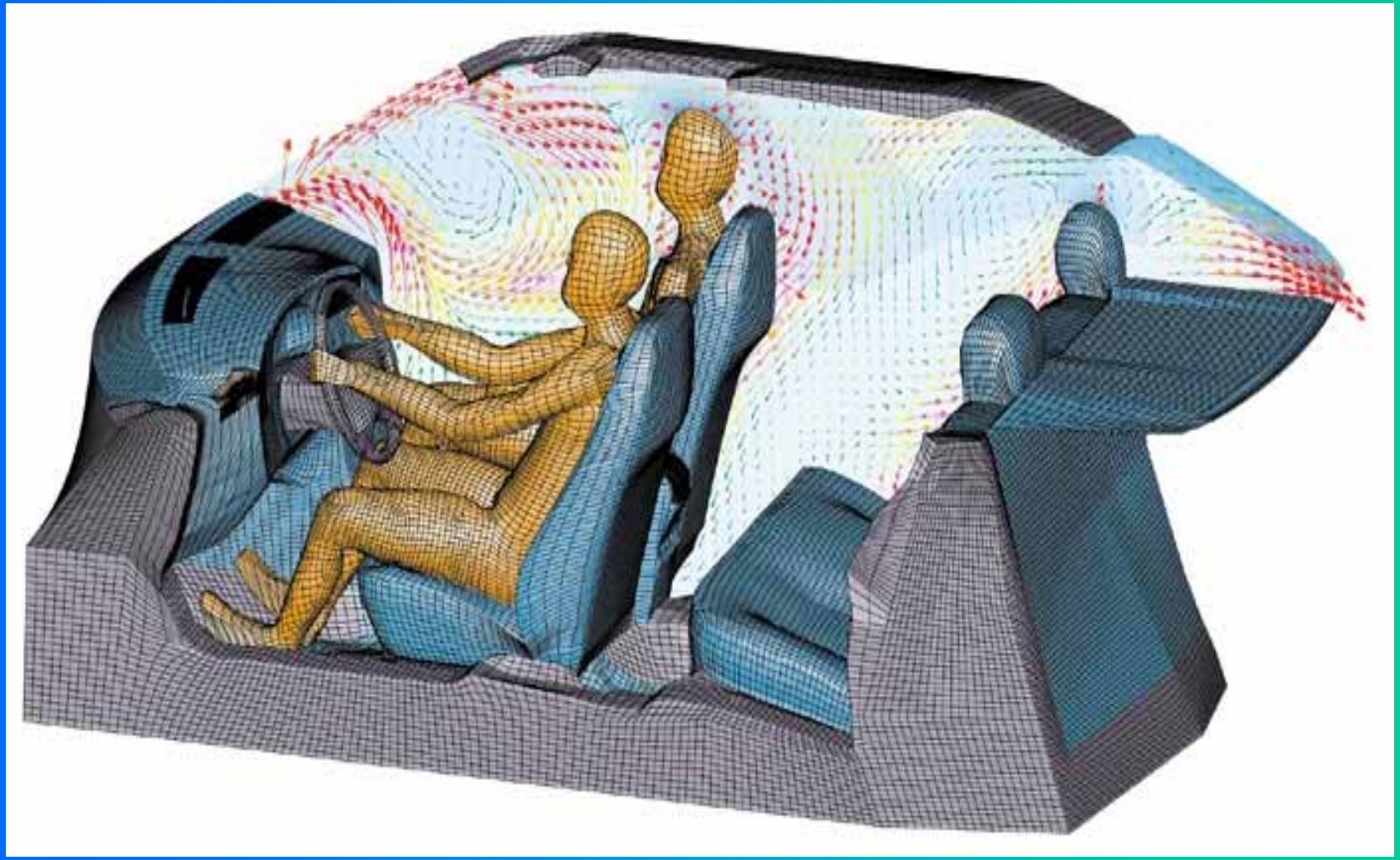
Mercedes E级车的压力分布



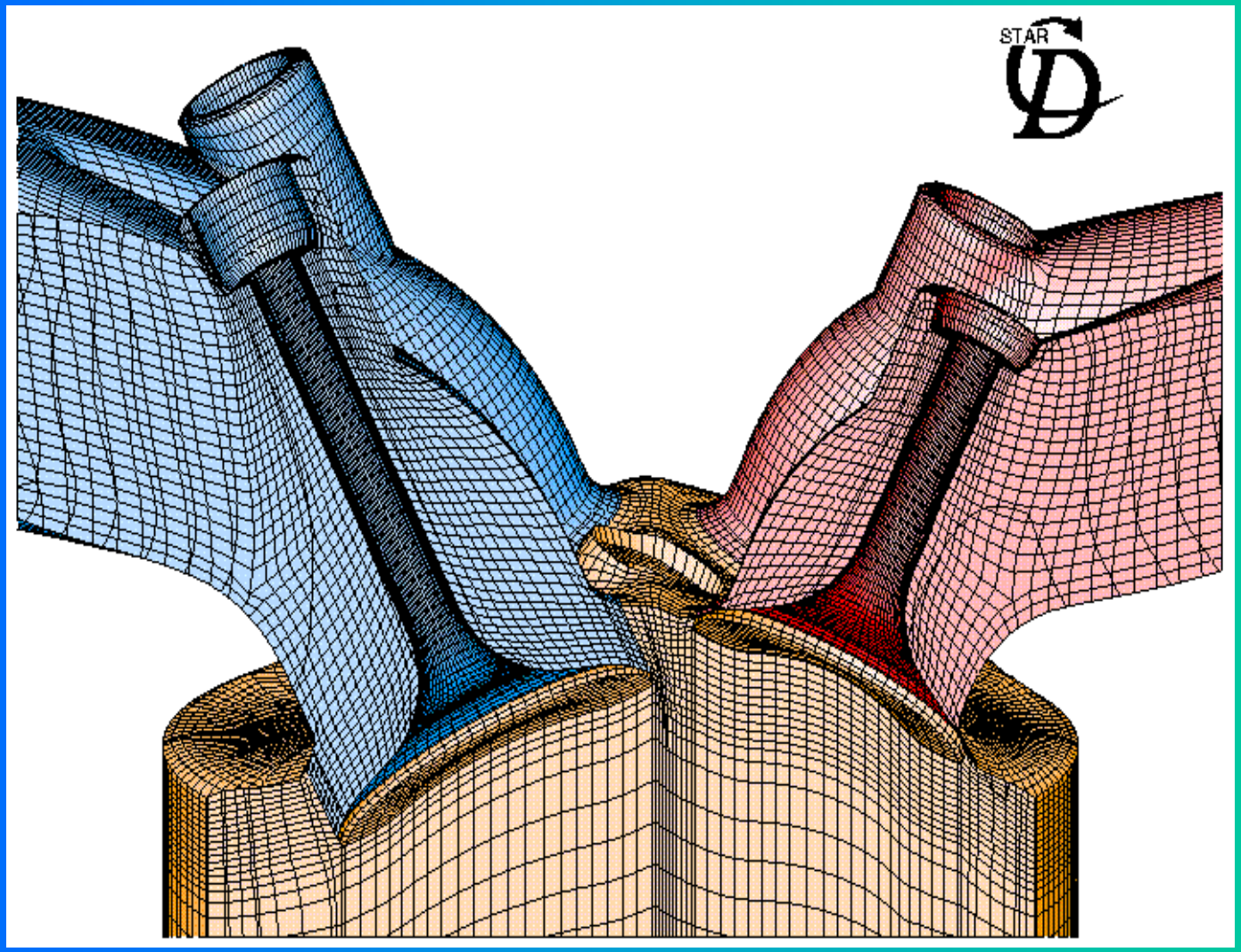
卡车流场



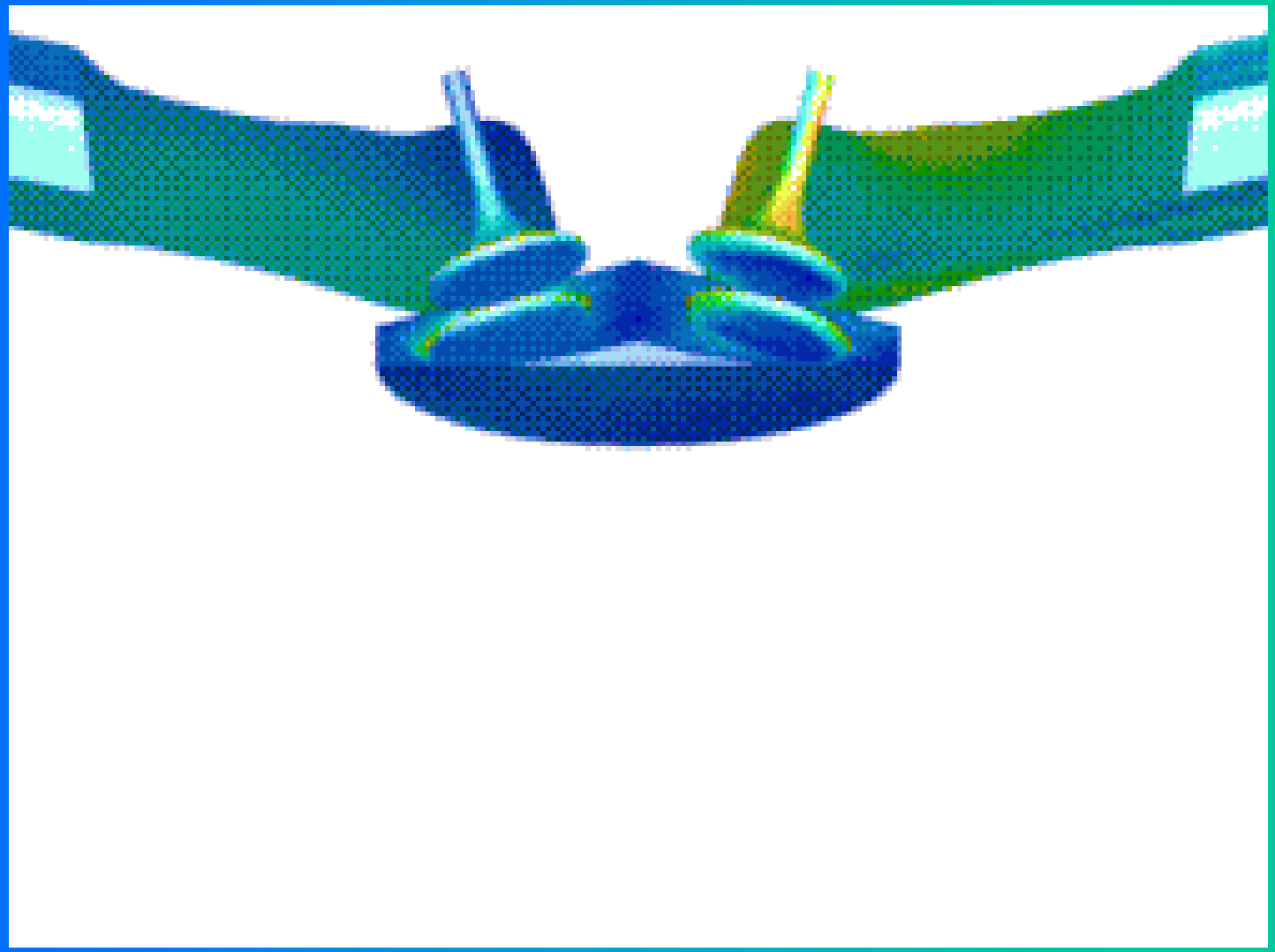
发动机舱内的传热分析



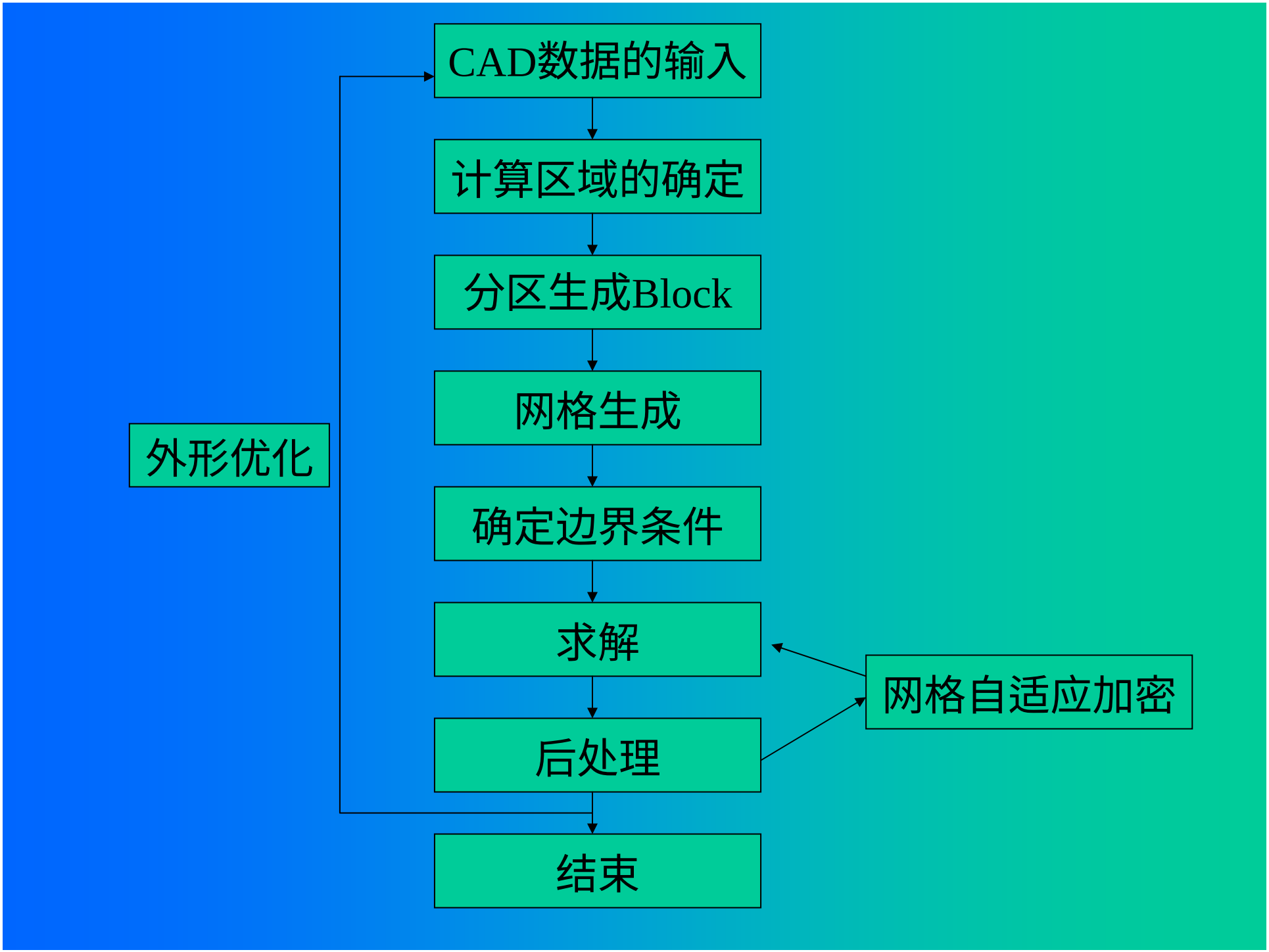
车内流场



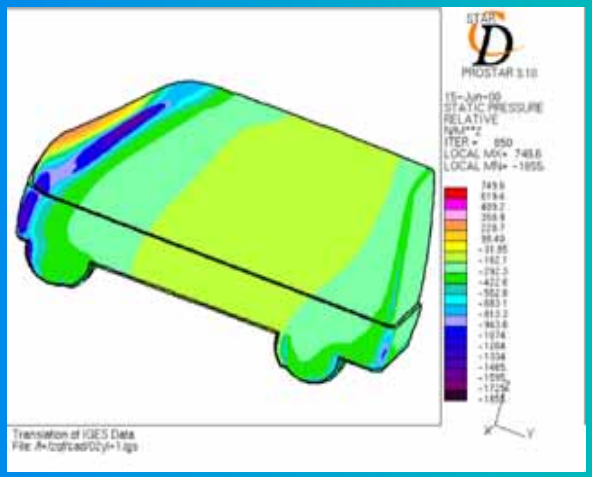
发动机进排气系统

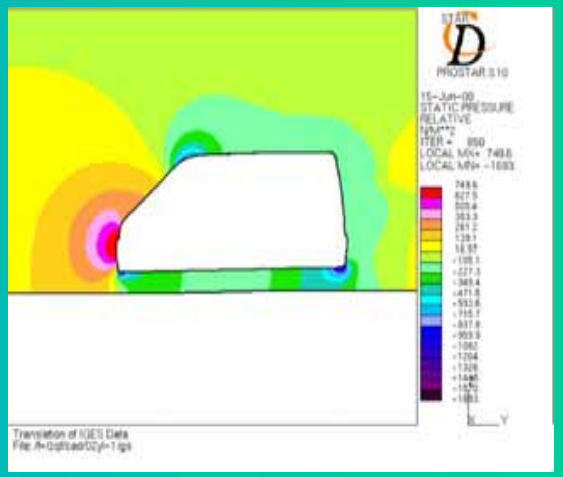


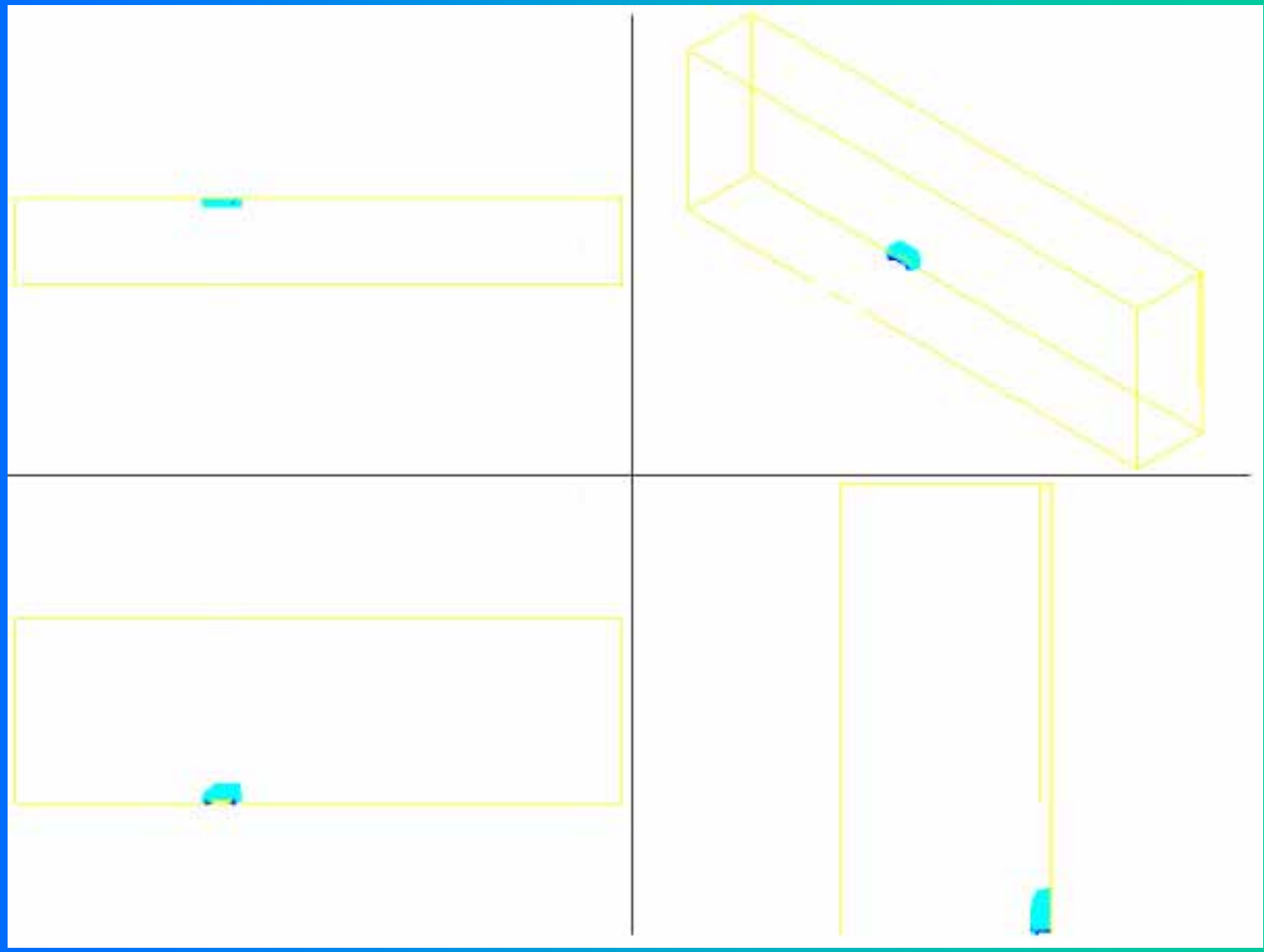
汽车外流场的模拟


CAD数据的输入
计算区域的确定
分区生成Block
网格生成
确定边界条件
求解
后处理
结束
外形优化
网格自适应加密

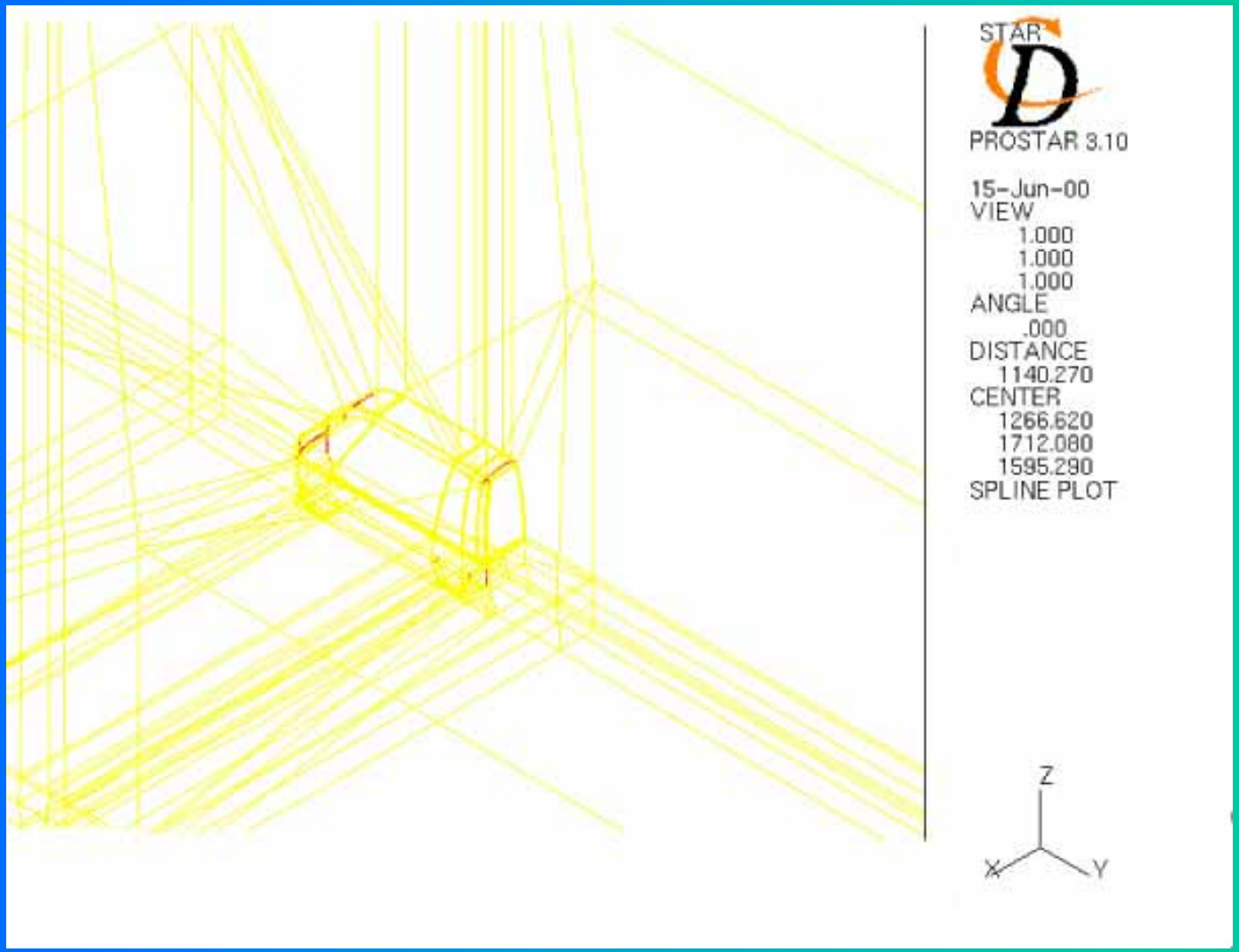
某一国产微型车外流场数值模拟



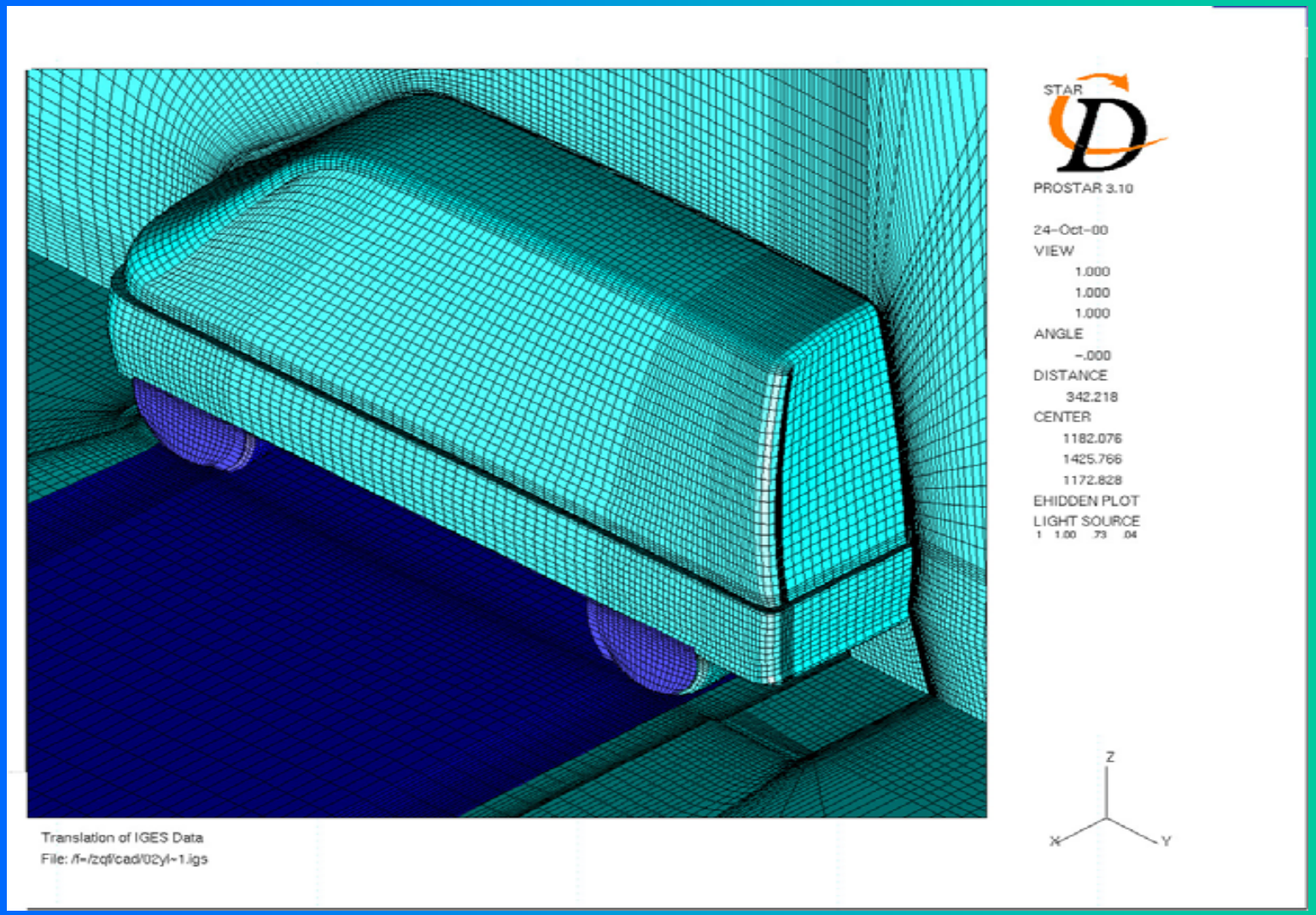




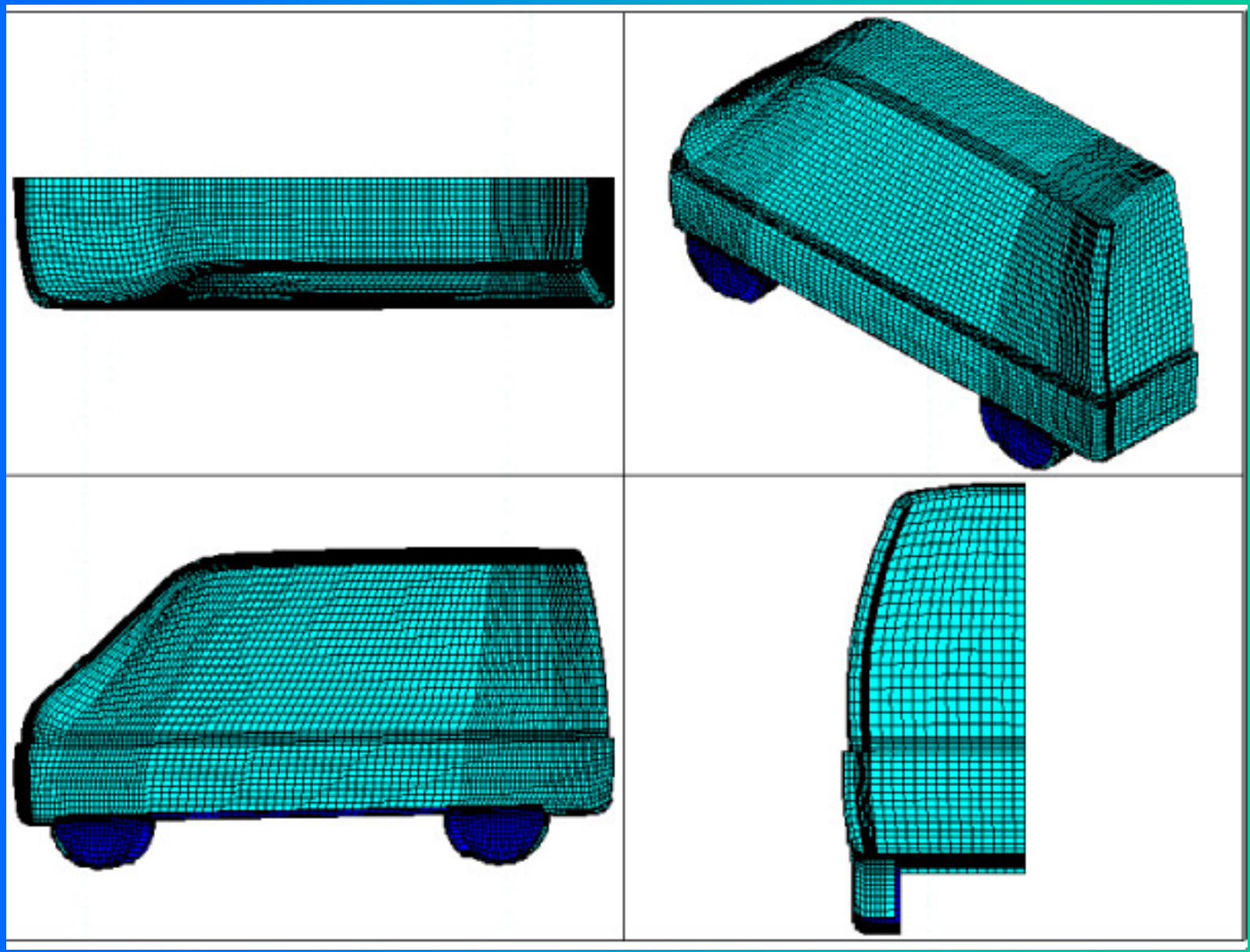
计算区域


STAR
PROSTAR 3.10
15-Jun-00
VIEW
1.000
1.000
1.000
ANGLE
.000
DISTANCE
1140.270
CENTER
1266.620
1712.080
1595.290
SPLINE PLOT
Z
X
Y

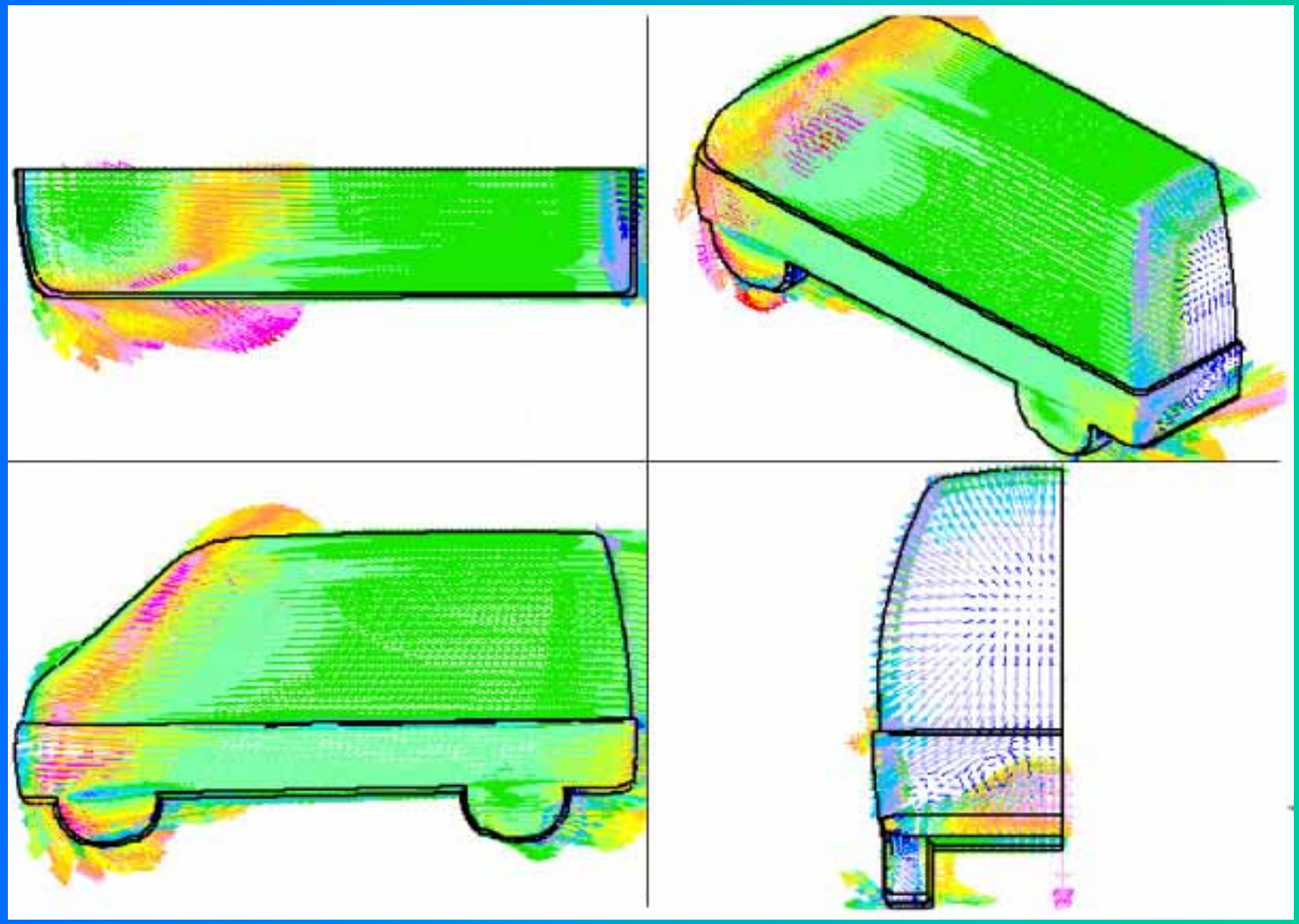
分区分布


STAR
PROSTAR 3.10
24-Oct-00
VIEW
1.000
1.000
1.000
ANGLE
-.000
DISTANCE
342.218
CENTER
1182.076
1425.766
1172.828
EHIDDEN PLOT
LIGHT SOURCE
1 1.00 .73 .04
Z
X
Y
Translation of IGES Data
File: /f~/zqf/cad/02yl~1.igs

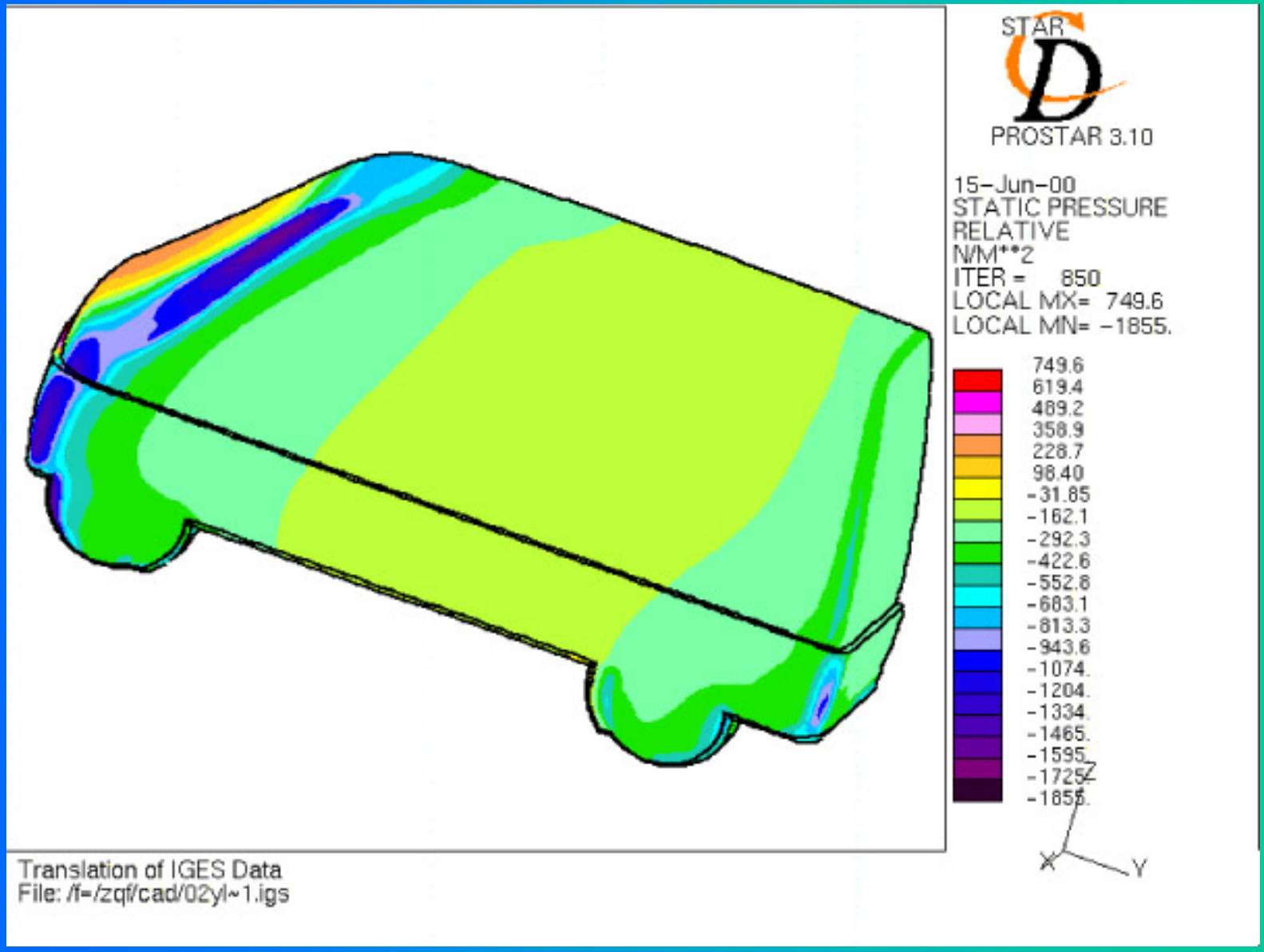
计算网格



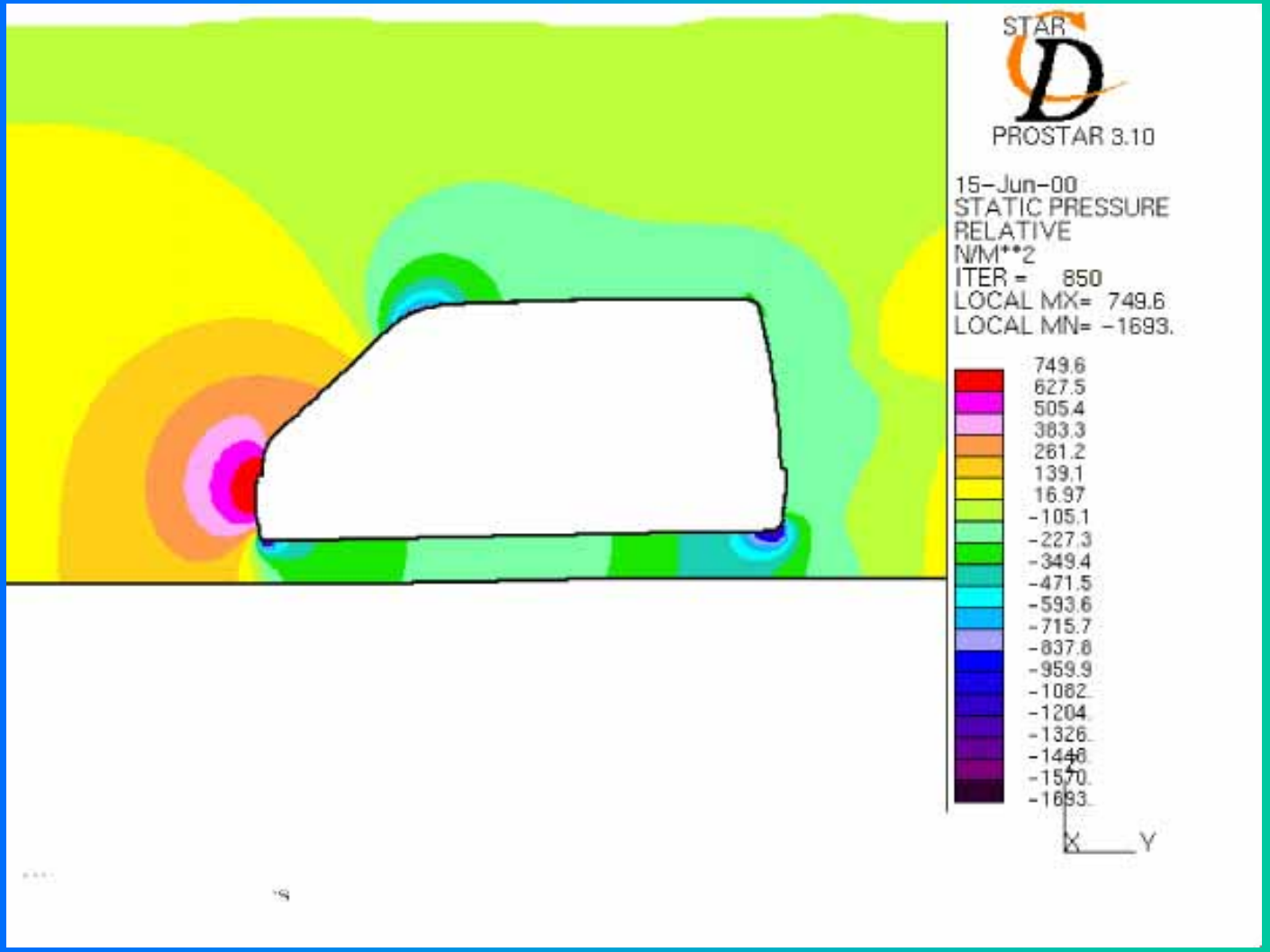
表面网格



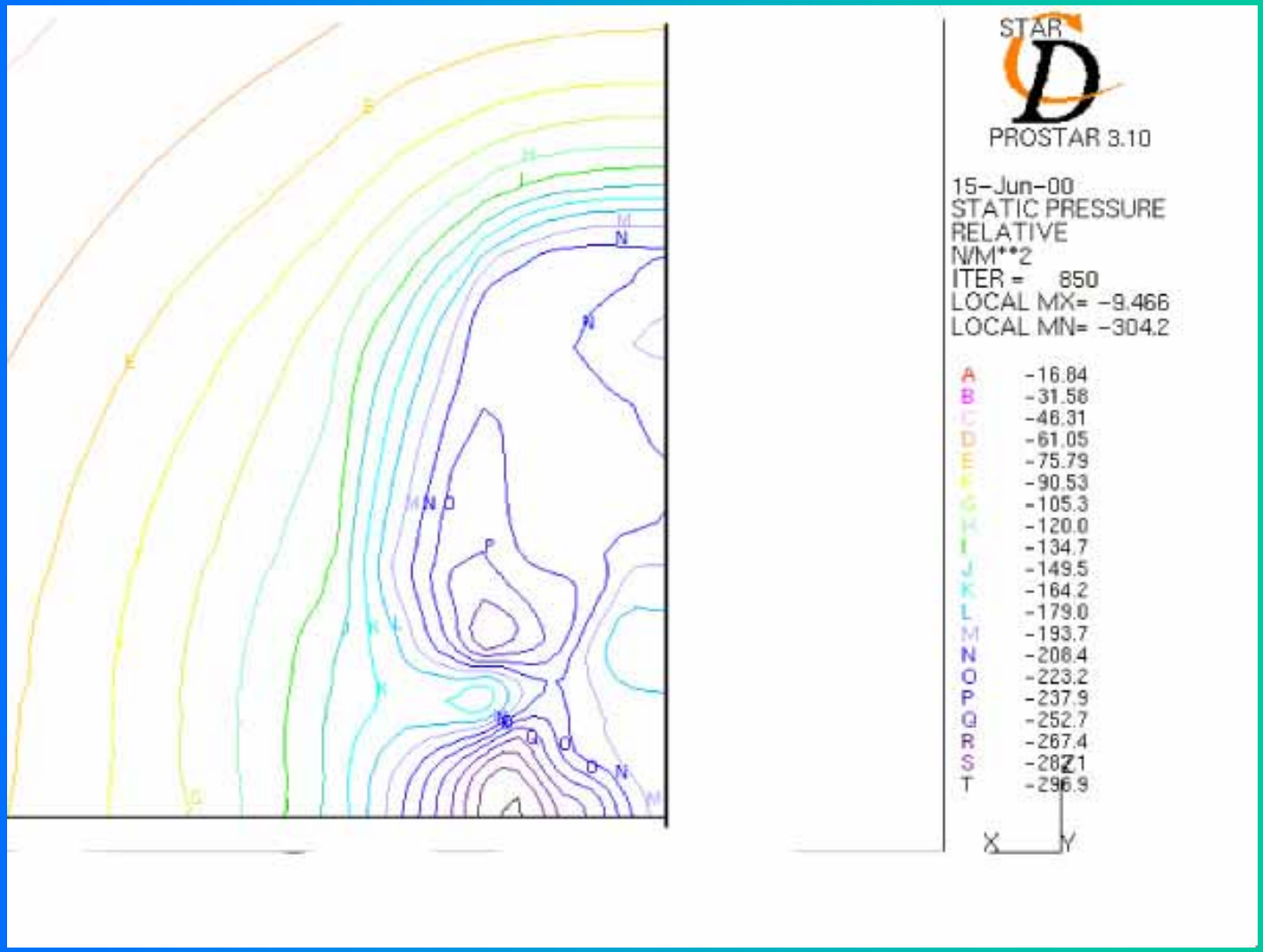
车身表面附近的速度矢量图


STAR
PROSTAR 3.10
15-Jun-00
STATIC PRESSURE
RELATIVE
N/M**2
ITER = 850
LOCAL MX= 749.6
LOCAL MN= -1855.
749.6
619.4
489.2
358.9
228.7
98.40
-31.85
-162.1
-292.3
-422.6
-552.8
-683.1
-813.3
-943.6
-1074.
-1204.
-1334.
-1465.
-1595.
-1725.
-1855.
Z
Y
Translation of IGES Data
File: /f=/zqf/cad/02yl~1.igs

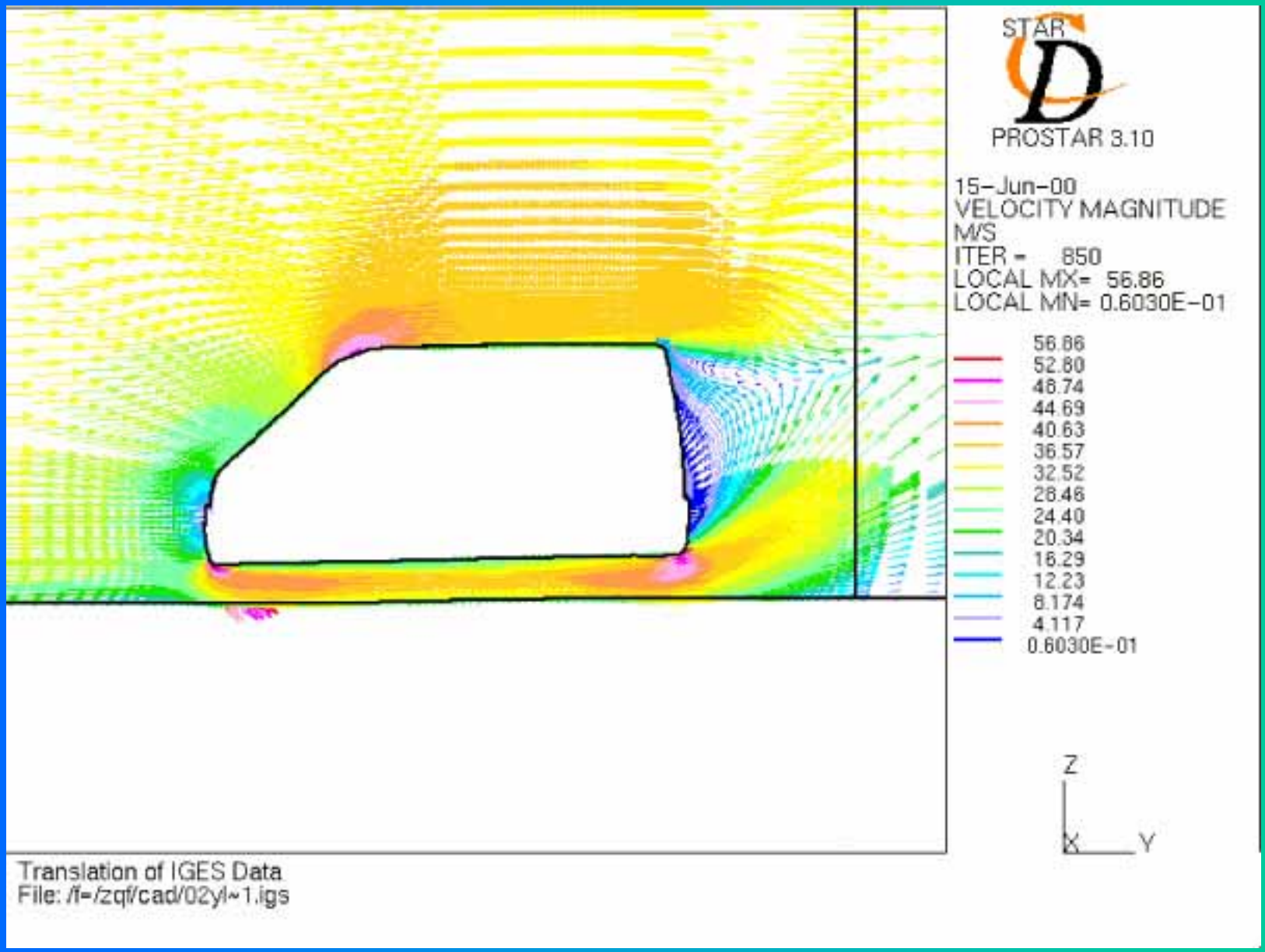
表面压力分布



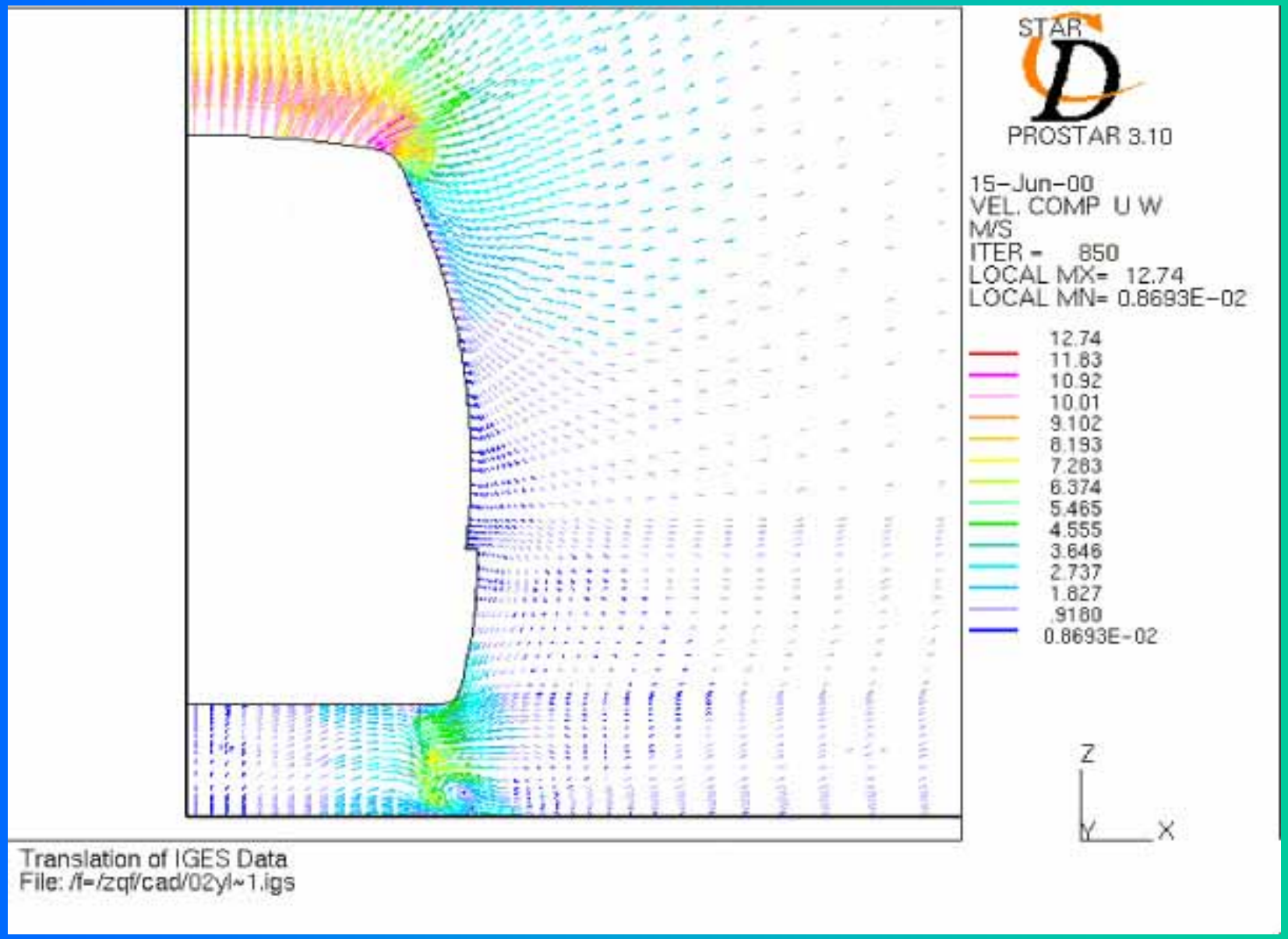
纵向对称平面内压力分布图


STAR
PROSTAR 3.10
15-Jun-00
STATIC PRESSURE
RELATIVE
N/M**2
ITER = 850
LOCAL MX= -9.466
LOCAL MN= -304.2
A -16.84
B -31.58
C -46.31
D -61.05
E -75.79
F -90.53
G -105.3
H -120.0
I -134.7
J -149.5
K -164.2
L -179.0
M -193.7
N -208.4
O -223.2
P -237.9
Q -252.7
R -267.4
S -282.1
T -296.9
X
Y

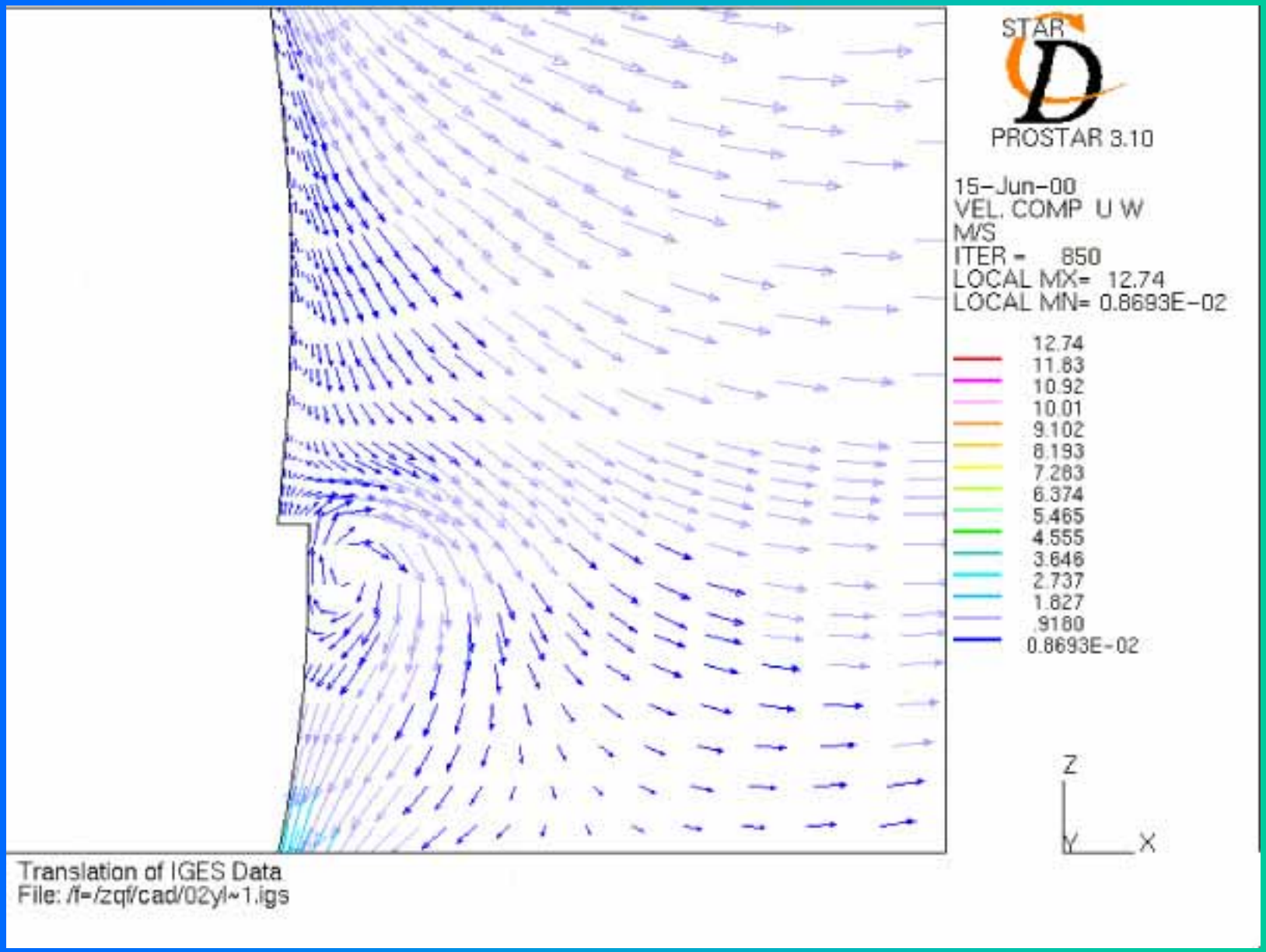
尾截面处压力分布图


STAR
PROSTAR 3.10
15-Jun-00
VELOCITY MAGNITUDE
M/S
ITER = 850
LOCAL MX= 56.86
LOCAL MN= 0.6030E-01
56.86
52.80
48.74
44.69
40.63
36.57
32.52
28.46
24.40
20.34
16.29
12.23
8.174
4.117
0.6030E-01
Z
X
Y
Translation of IGES Data
File: /f=/zqf/cad/02yl~1.igs

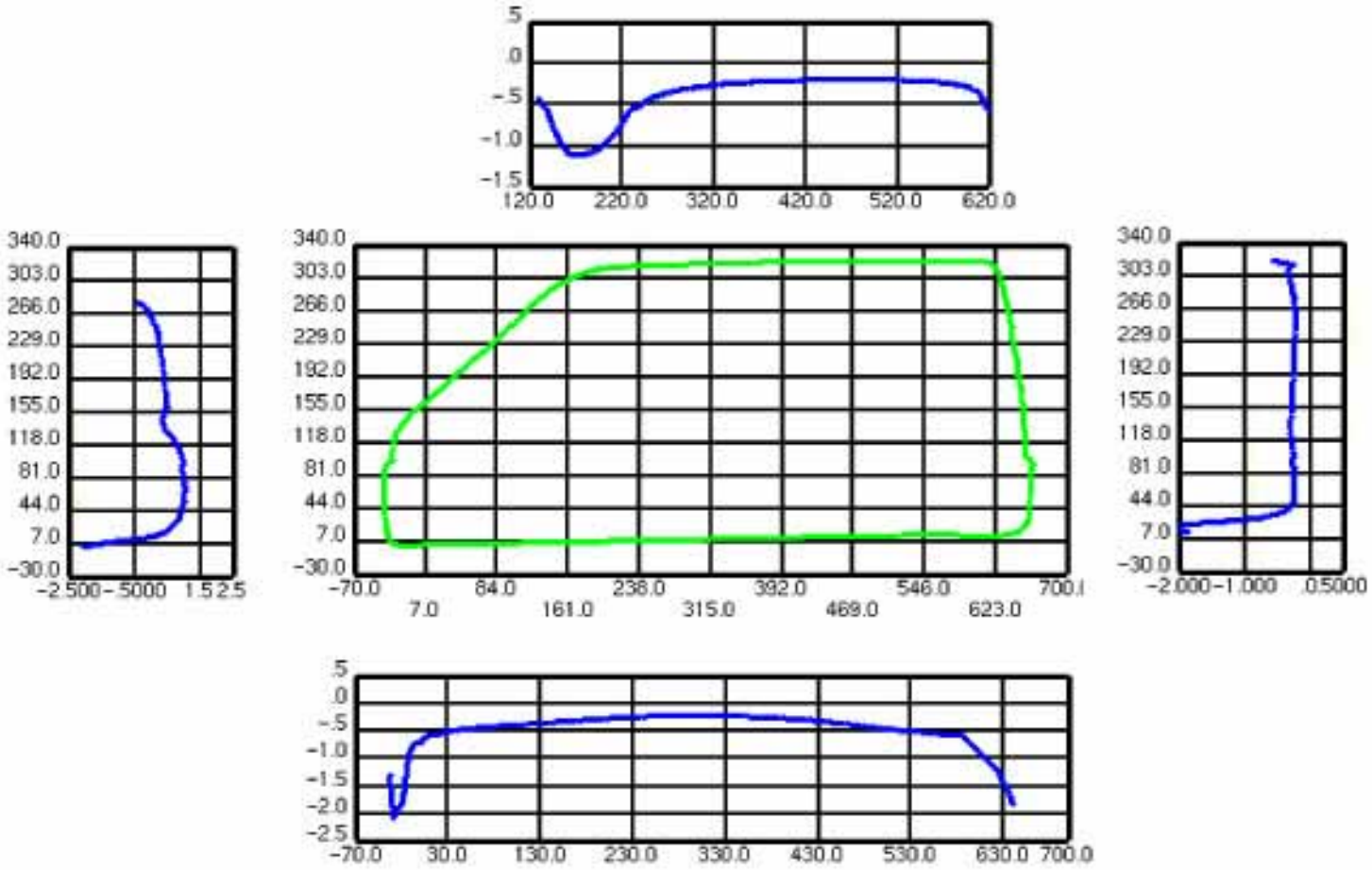
对称平面速度矢量图



车身中部横截面内速度矢量图


STAR
PROSTAR 3.10
15-Jun-00
VEL. COMP U W
M/S
ITER = 850
LOCAL MX= 12.74
LOCAL MN= 0.8693E-02
12.74
11.83
10.92
10.01
9.102
8.193
7.283
6.374
5.465
4.555
3.646
2.737
1.827
.9160
0.8693E-02
Z
Y
X
Translation of IGES Data
File: /f=/zqf/cad/02yl~1.igs

外流场流线图

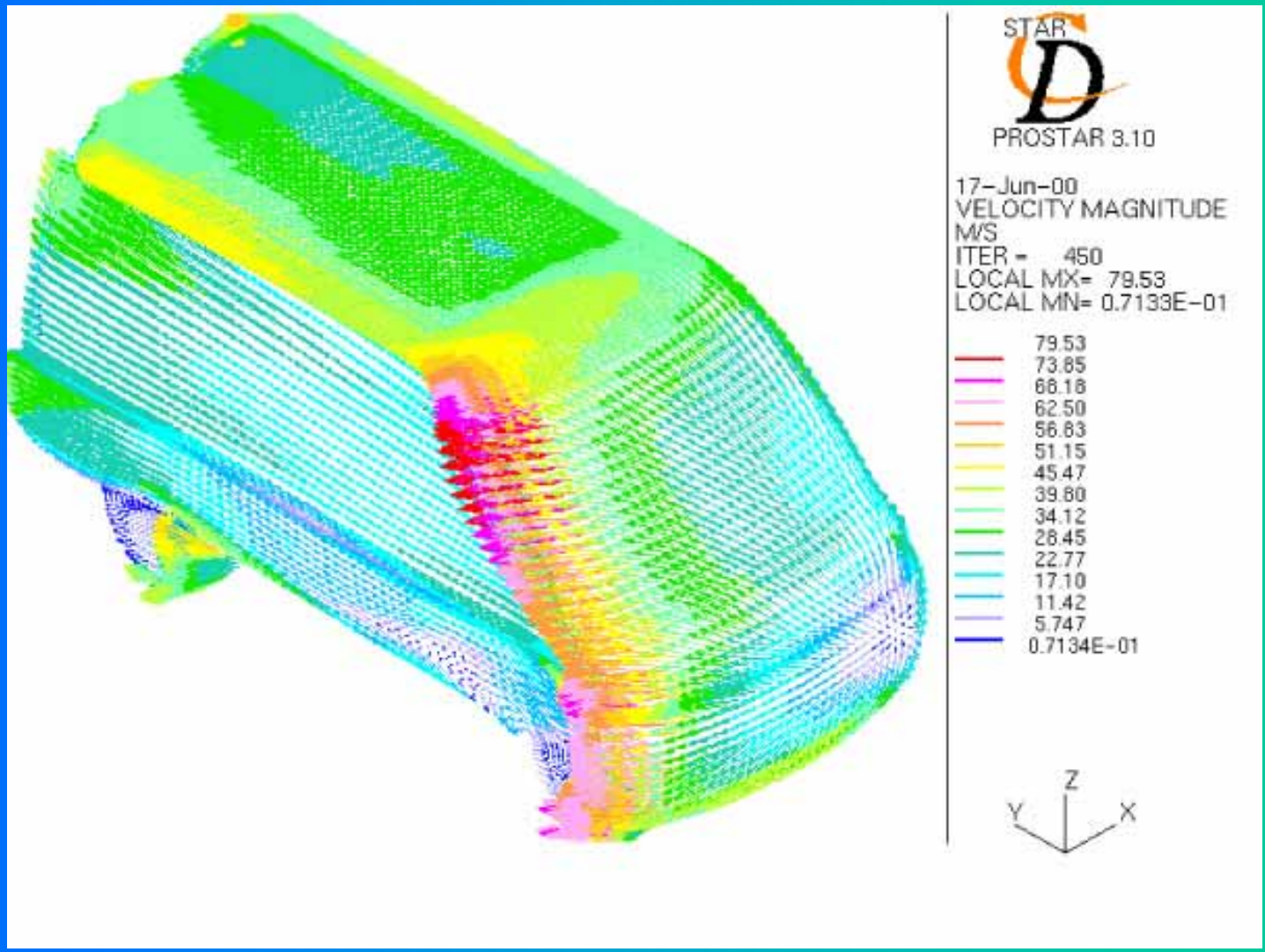

5
0
-.5
-1.0
-1.5
120.0 220.0 320.0 420.0 520.0 620.0
340.0
303.0
266.0
229.0
192.0
155.0
118.0
81.0
44.0
7.0
-30.0
-2.500 -.5000 1.5 2.5
340.0
303.0
266.0
229.0
192.0
155.0
118.0
81.0
44.0
7.0
-30.0
-70.0 84.0 238.0 392.0 546.0 700.0
7.0 161.0 315.0 469.0 623.0
340.0
303.0
266.0
229.0
192.0
155.0
118.0
81.0
44.0
7.0
-30.0
-2.000 -1.000 .5000
5
0
-.5
-1.0
-1.5
-2.0
-2.5
-70.0 30.0 130.0 230.0 330.0 430.0 530.0 630.0 700.0

对称平面压力系数

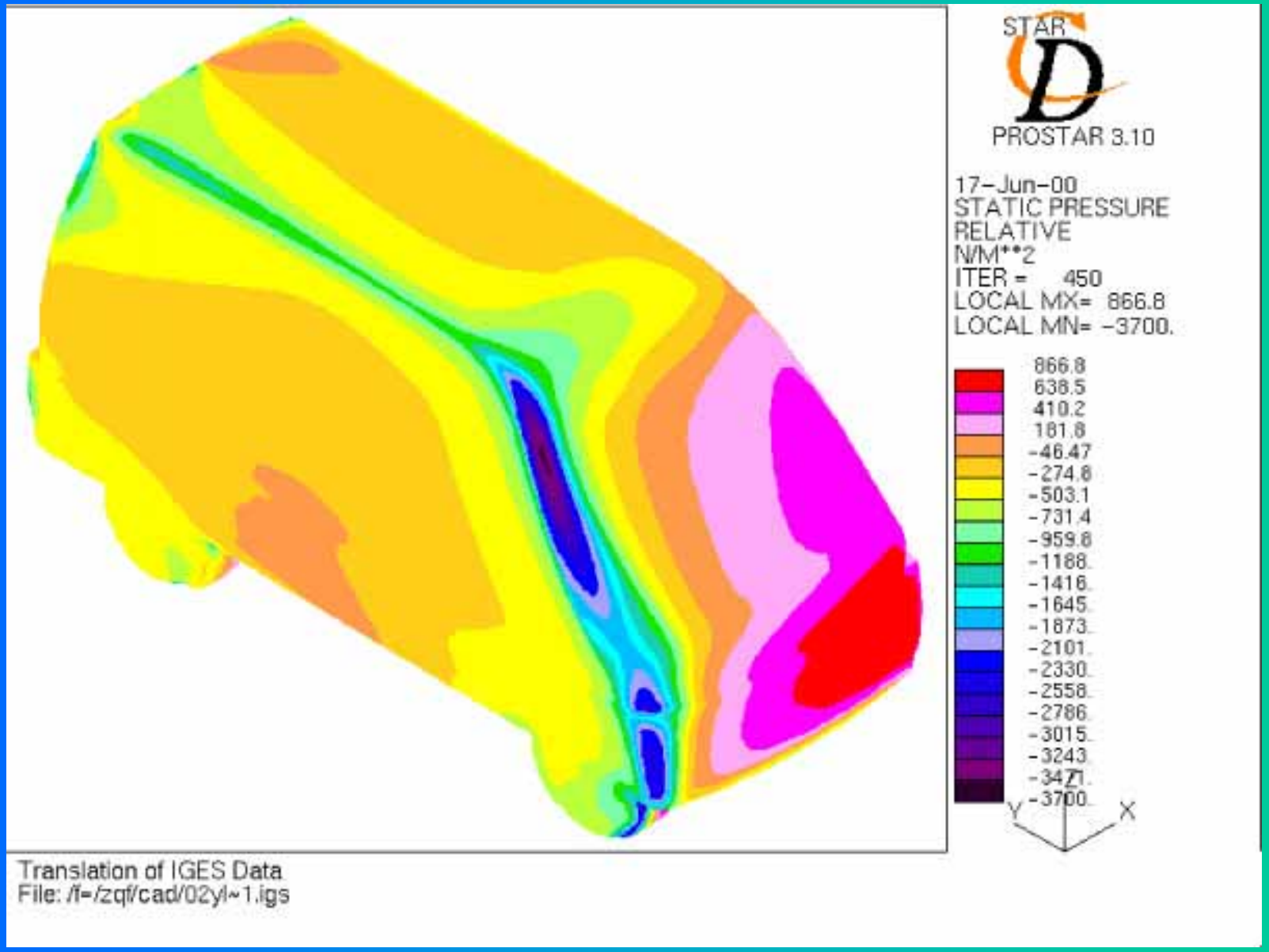
无气流偏角工况下试验值与模拟值比较

风阻系数试验值C_D=0.365

风阻系数模拟值C_D=0.395

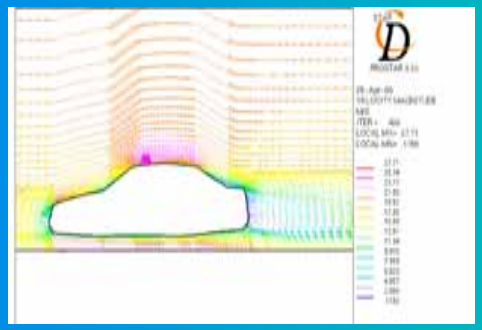


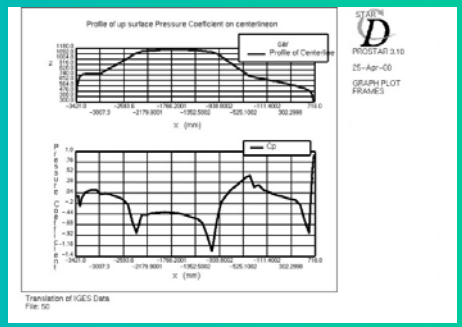
车身表面附近的速度矢量图

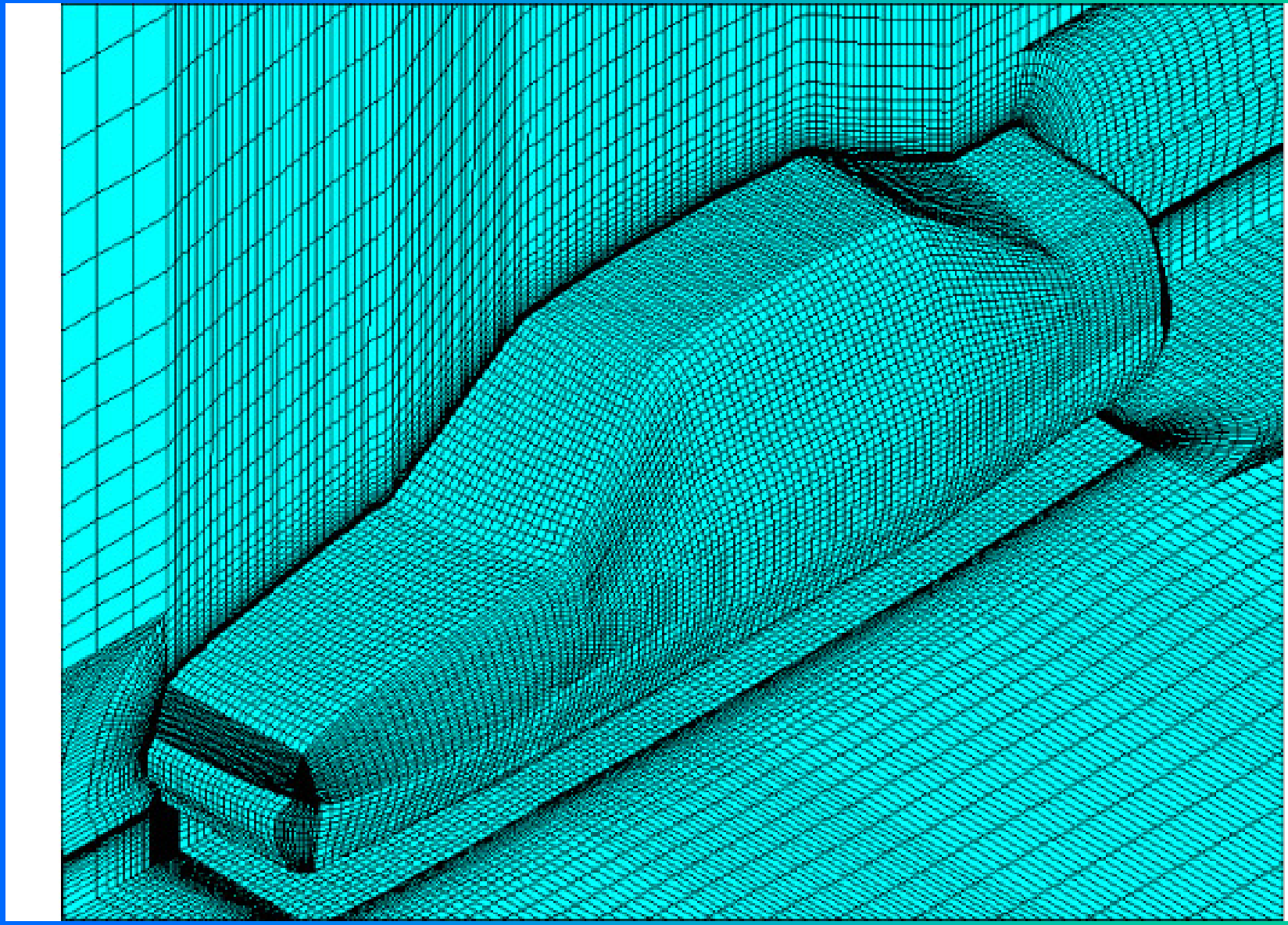


气流偏角下的车身表面压力分布

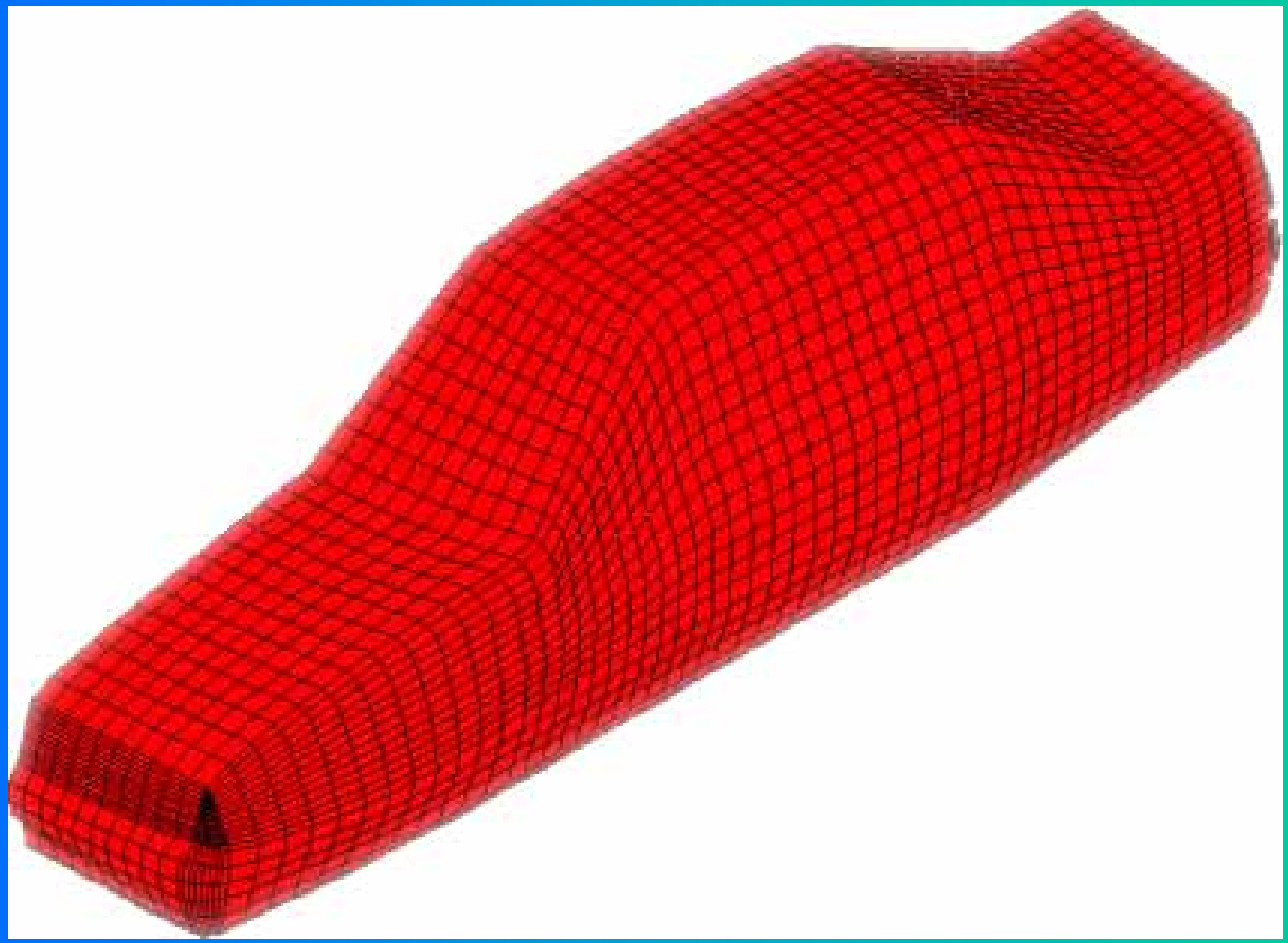
某一简化车型外流场数值模拟



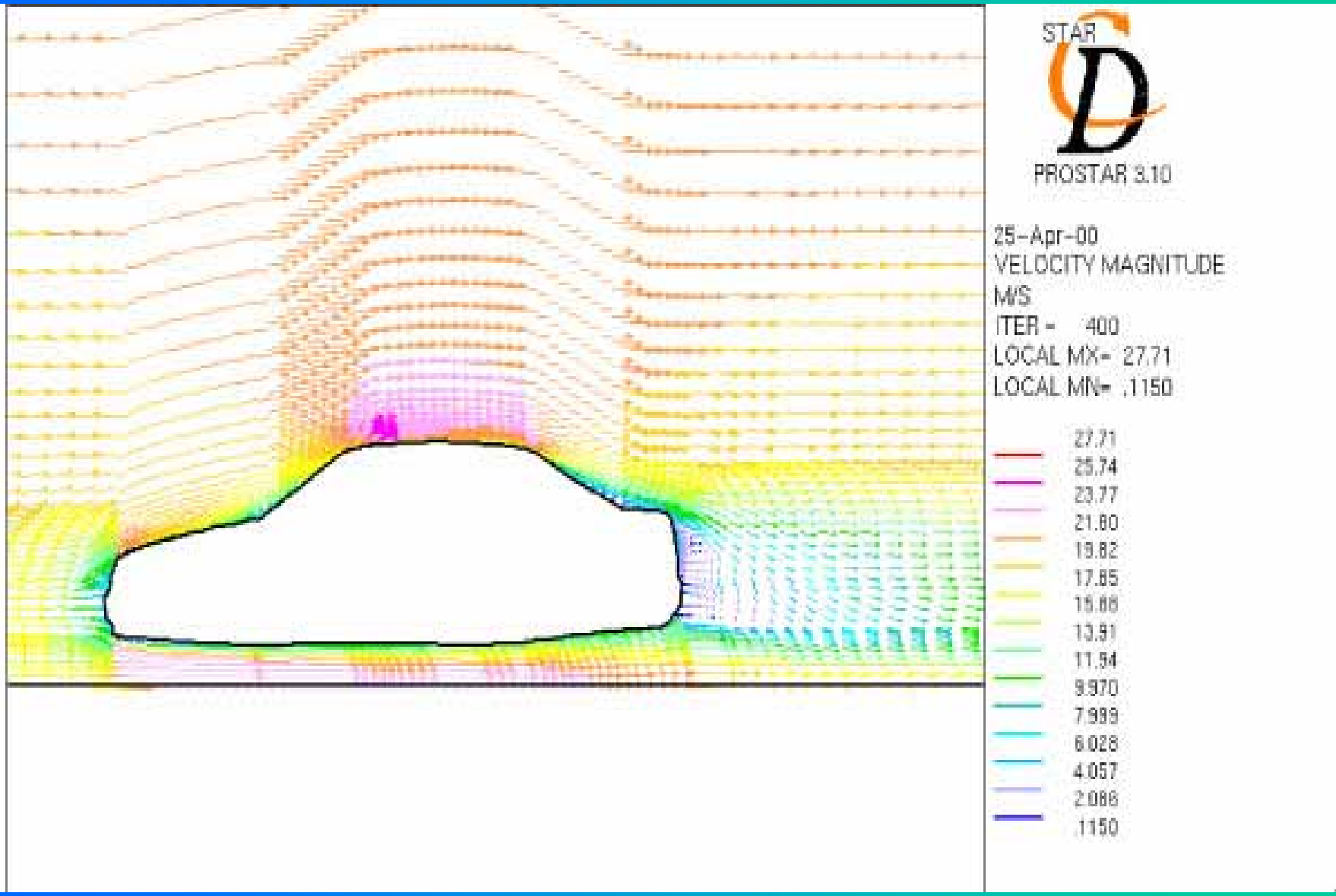




生成的网格



车身表面网格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25-Apr-00
VELOCITY MAGNITUDE
M/S
ITER = 400
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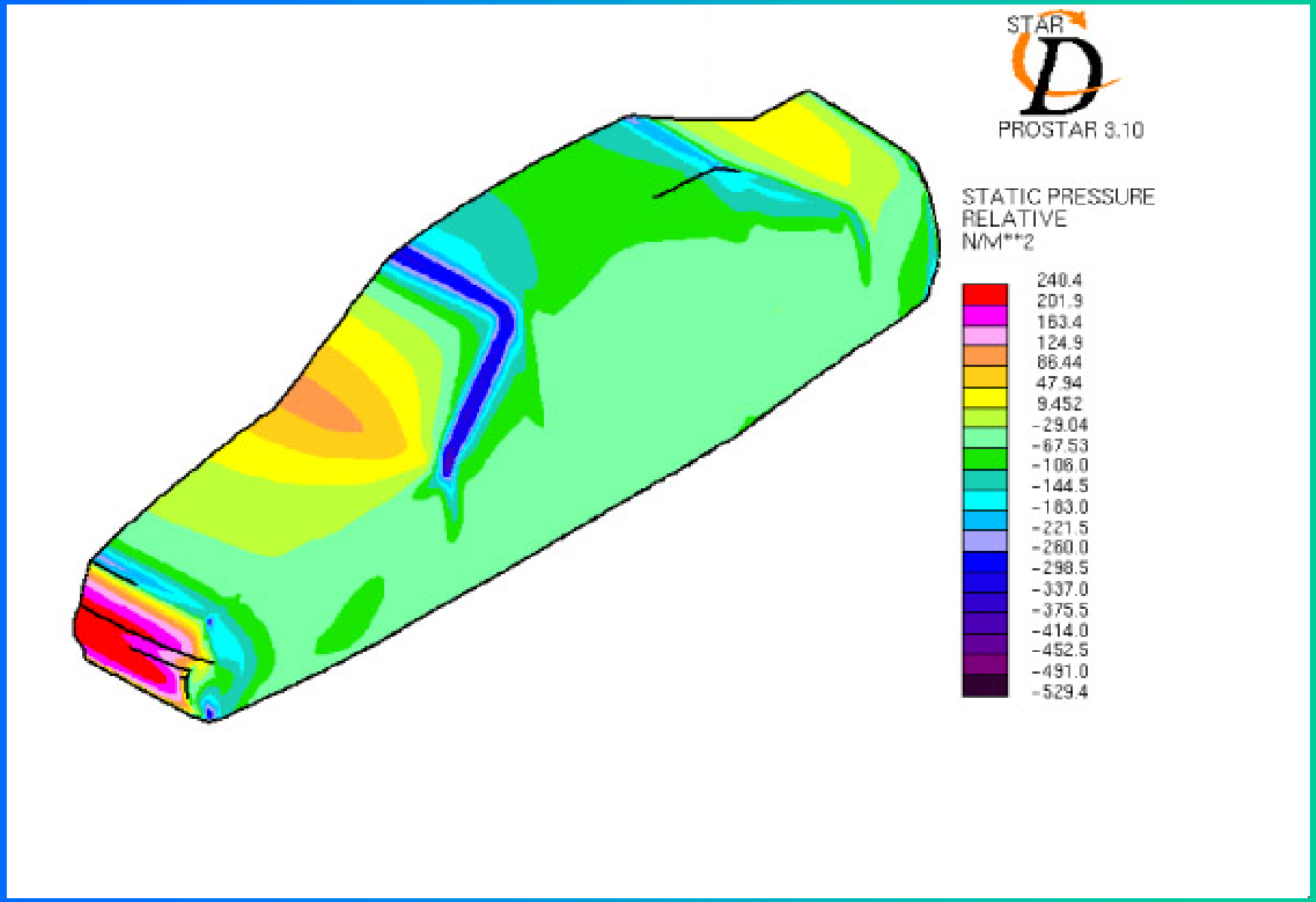
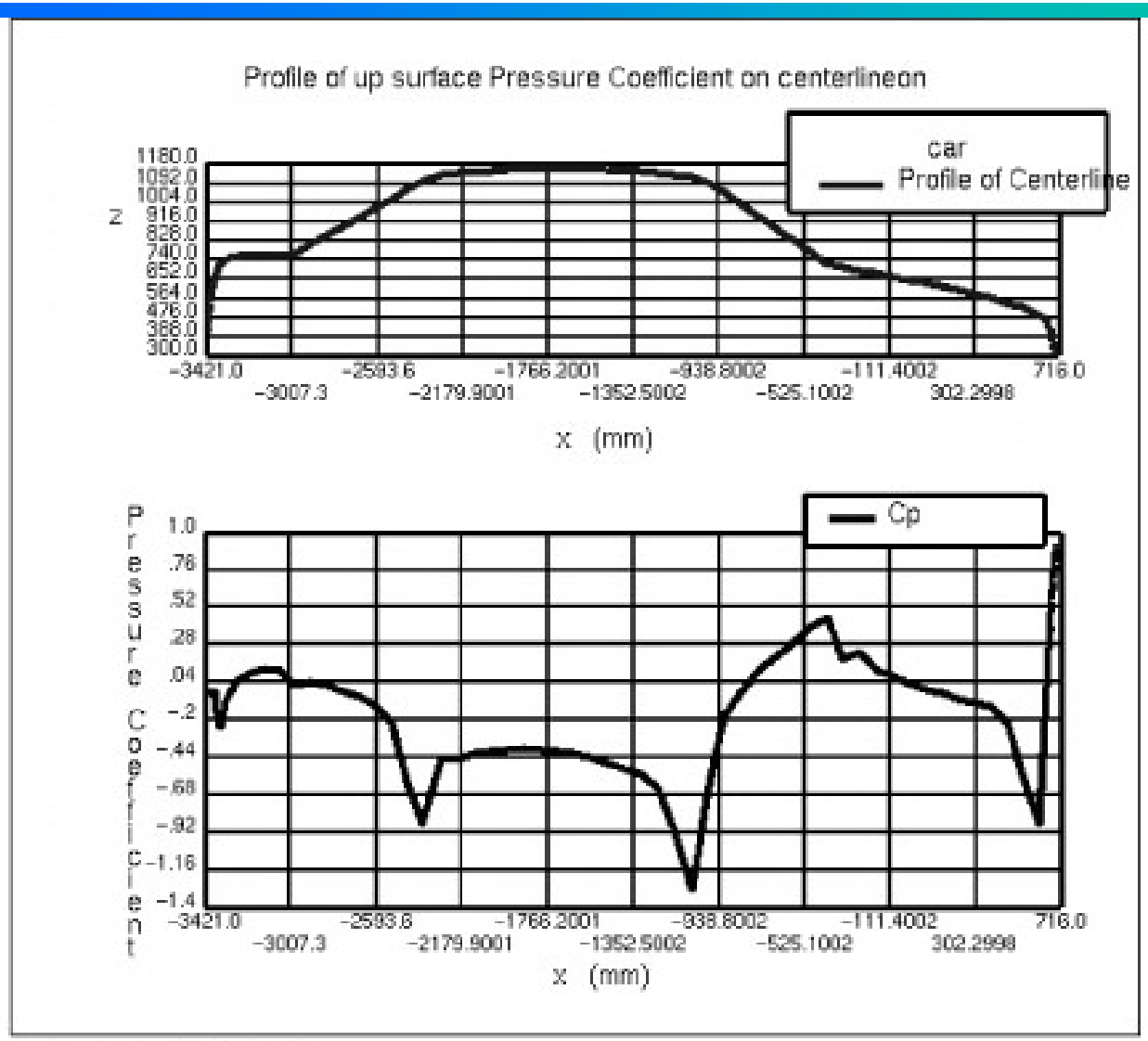
LOCAL MN= .1150
27.71
25.74
23.77
21.80
19.82
17.85
15.88
13.91
11.94
9.970
7.989
6.028
4.057
2.086
.1150

外流速度场


STAR
PROSTAR 3.10
STATIC PRESSURE
RELATIVE
N/M**2
240.4
201.9
163.4
124.9
86.44
47.94
9.452
-29.04
-67.53
-106.0
-144.5
-183.0
-221.5
-260.0
-298.5
-337.0
-375.5
-414.0
-452.5
-491.0
-529.4

车身表面静压分布图



STAR

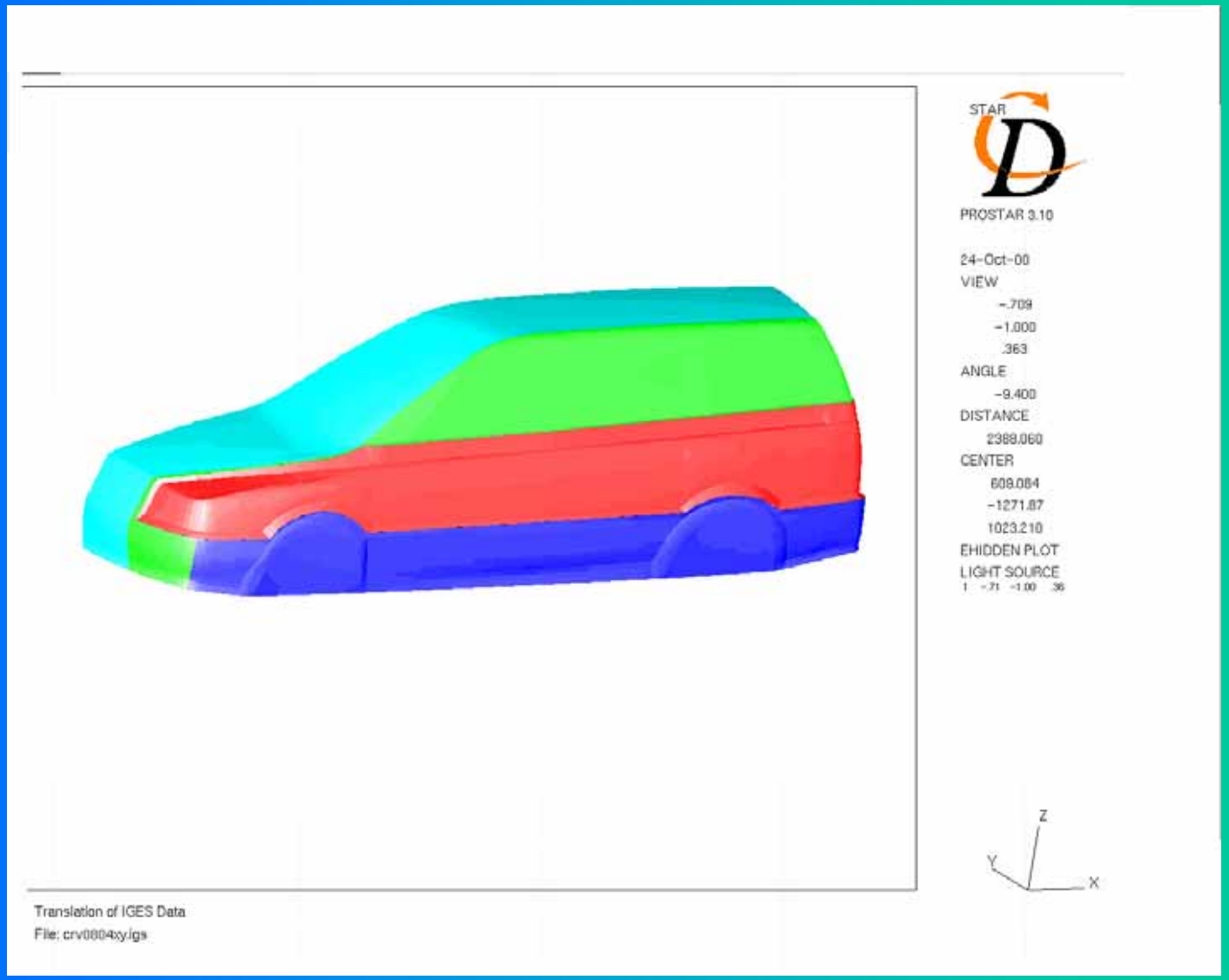
PROSTAR 3.10

25-Apr-00

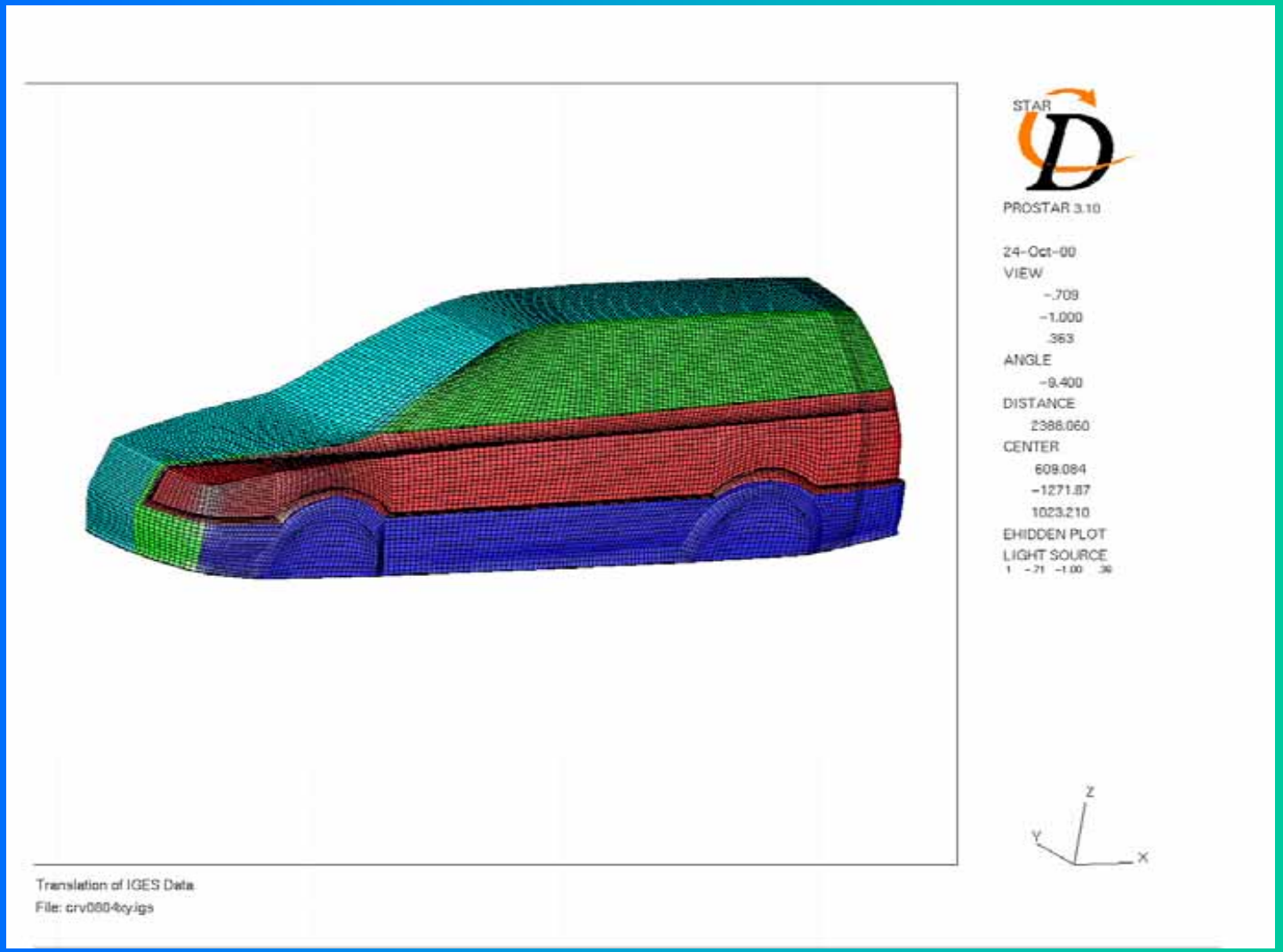
GRAPH PLOT
FRAMES

Translation of IGES Data
File: 50

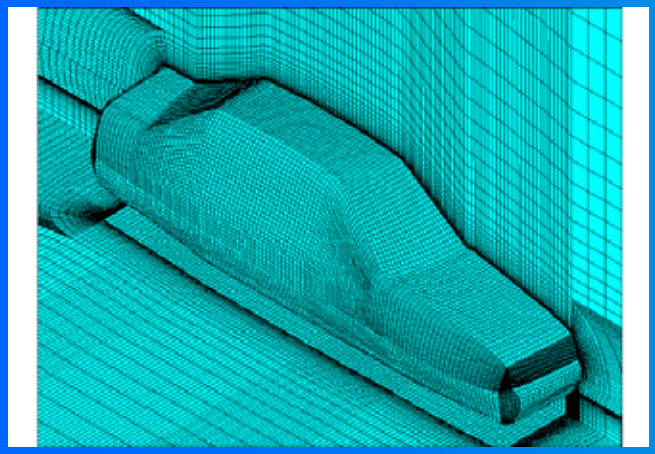
车身对称面内压力系数

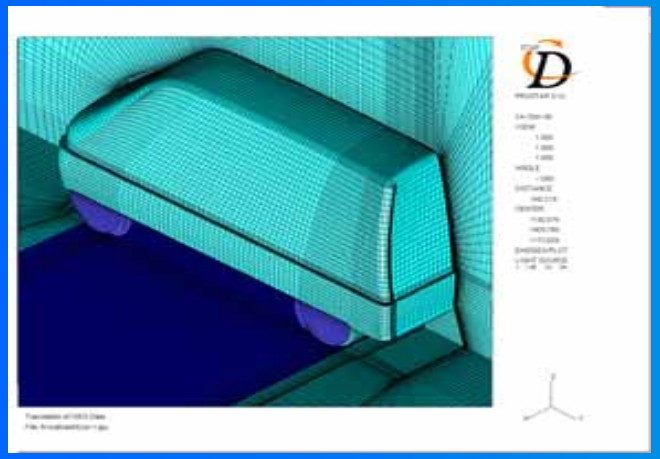

STAR
PROSTAR 3.10
24-Oct-00
VIEW
-.709
-1.000
.363
ANGLE
-9.400
DISTANCE
2388.060
CENTER
609.084
-1271.87
1023.210
EHIDDEN PLOT
LIGHT SOURCE
Z
Y
X
Translation of IGES Data
File: crv0804xy.igs

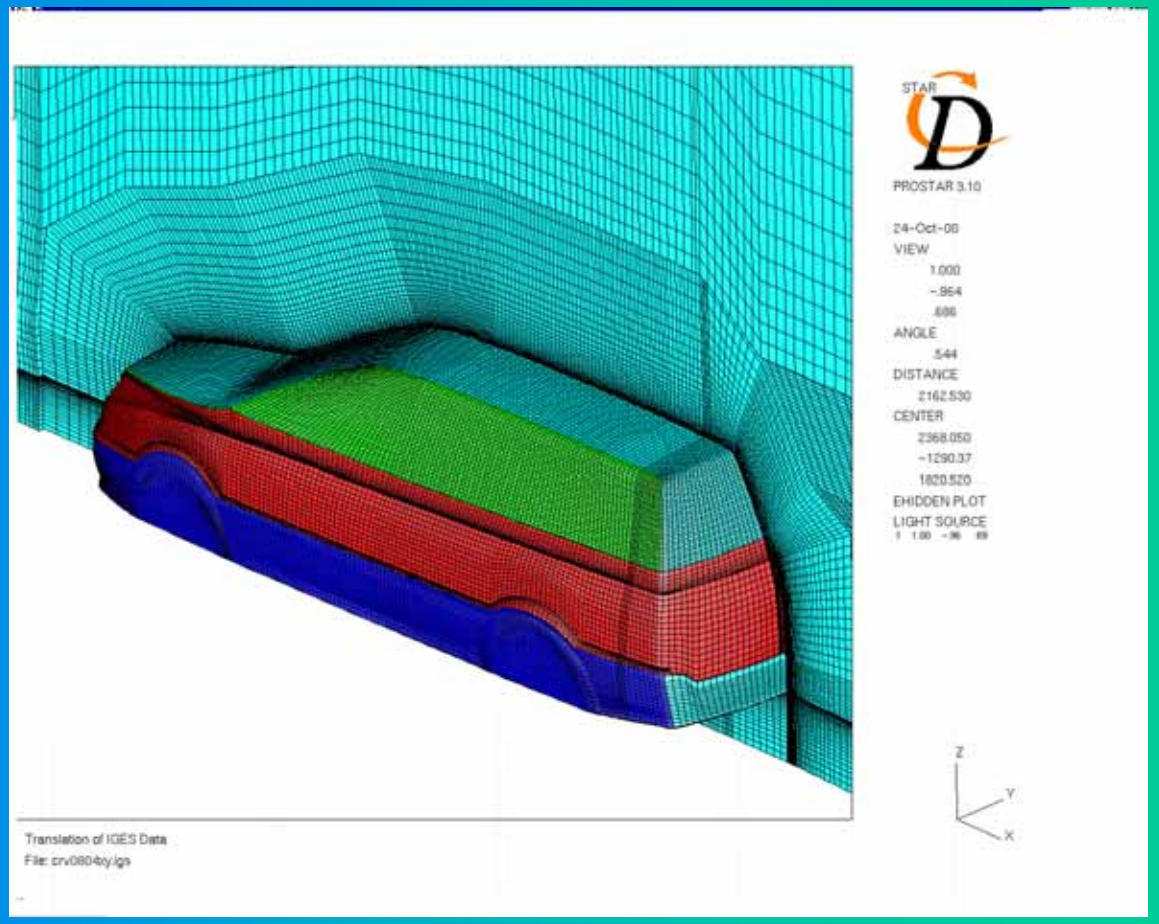
车身外形


STAR
PROSTAR 3.10
24-Oct-00
VIEW
-.709
-1.000
.363
ANGLE
-9.400
DISTANCE
2386.060
CENTER
609.084
-1271.87
1023.210
EHIDDEN PLOT
LIGHT SOURCE
Z
Y
X
Translation of IGES Data
File: crv0804cy.igs

车身表面网格

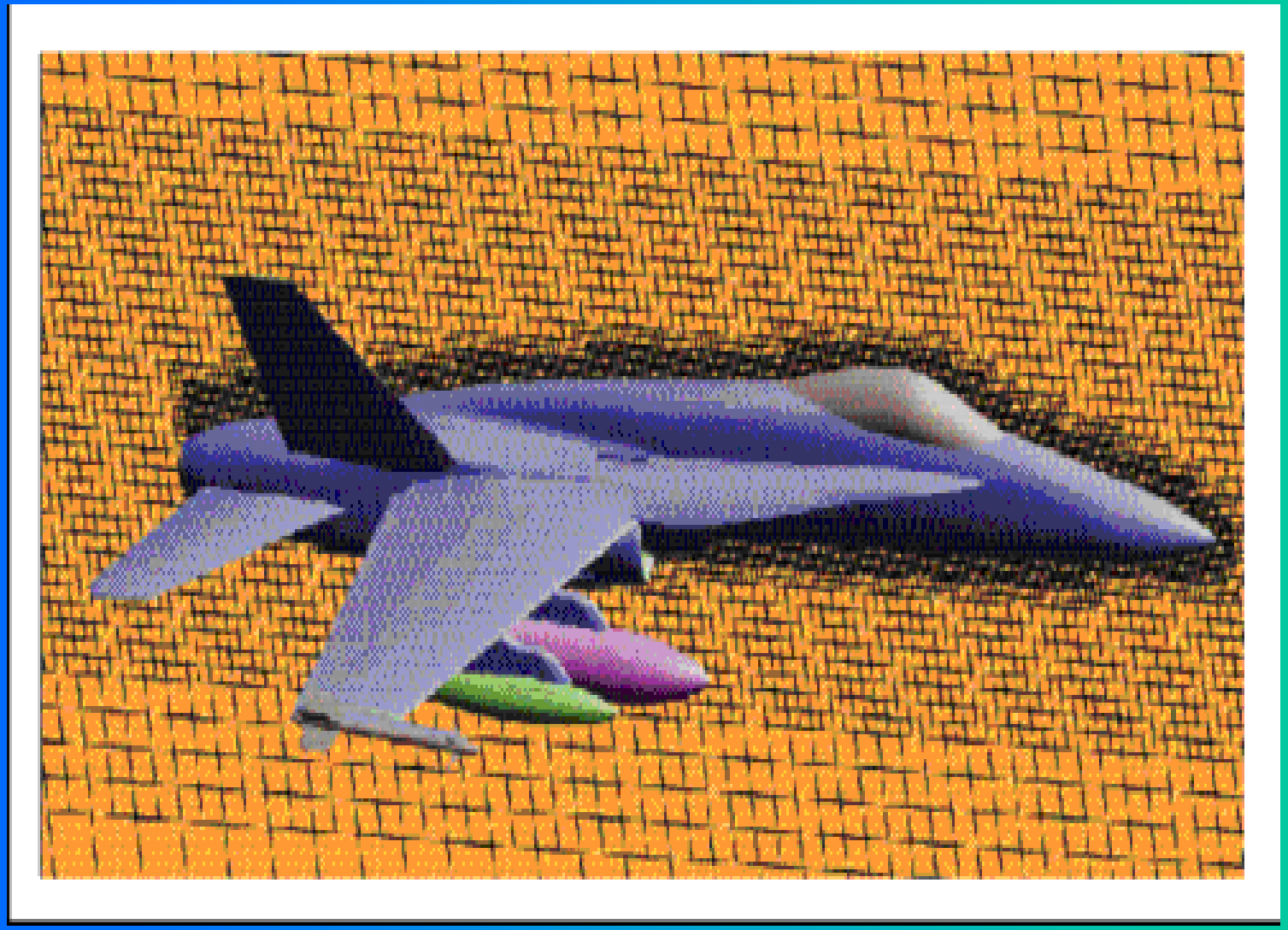






网格密度连续

网格密度非连续



F-18 用Pro-am生成的网格