A primer: Understanding the relationship between ride height, strut axis inclination and roll center on a MacPherson strut suspension.

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These examples and the admittedly brief discussion points are only meant to help understand the relationship between changes in ride height, strut inclination and roll center. The diagram used is a demo model within WinGEO and all screenshots come directly from WinGEO. The purpose is only to help the reader understand relationships, not the optimal values for any specific application.

In the 8 figures provided, the following suspension parameters will be adjusted:

A 2" drop in ride height. The principle effect of which is the change in angle of the lower control arms (LCA).

Using virtual "camber plates", the upper strut mounting point is moved inward in the "negative" camber direction a total of 2".

For each scenario, figures of a 4 deg. roll are also provided. This would be equivalent to heavy cornering on relatively soft springs.

Figure 1

Figure 1 depicts a basic strut suspension, as viewed from the front. Note in the upper left corner "Ride" is ride height, and "Roll" is the degrees of roll. Note the location of the Roll Cen (roll center, "RC") at 3.432" above ground, in the center of the front track, marked by a blue X in a brown box. The brown lines denote where the Ins.Cen., instance centers are loacted. Note the brown lines coming off the top of the strut are 90 deg. to the strut inclination, and pass through the inner two pivot points in the lower control arm (LCA). They intersect outside the track, the distance of which is noted as Ins.Cen. Negative numbers are to the drivers left and positive to the right. The roll examples would be equivalent to a left-hand turn.

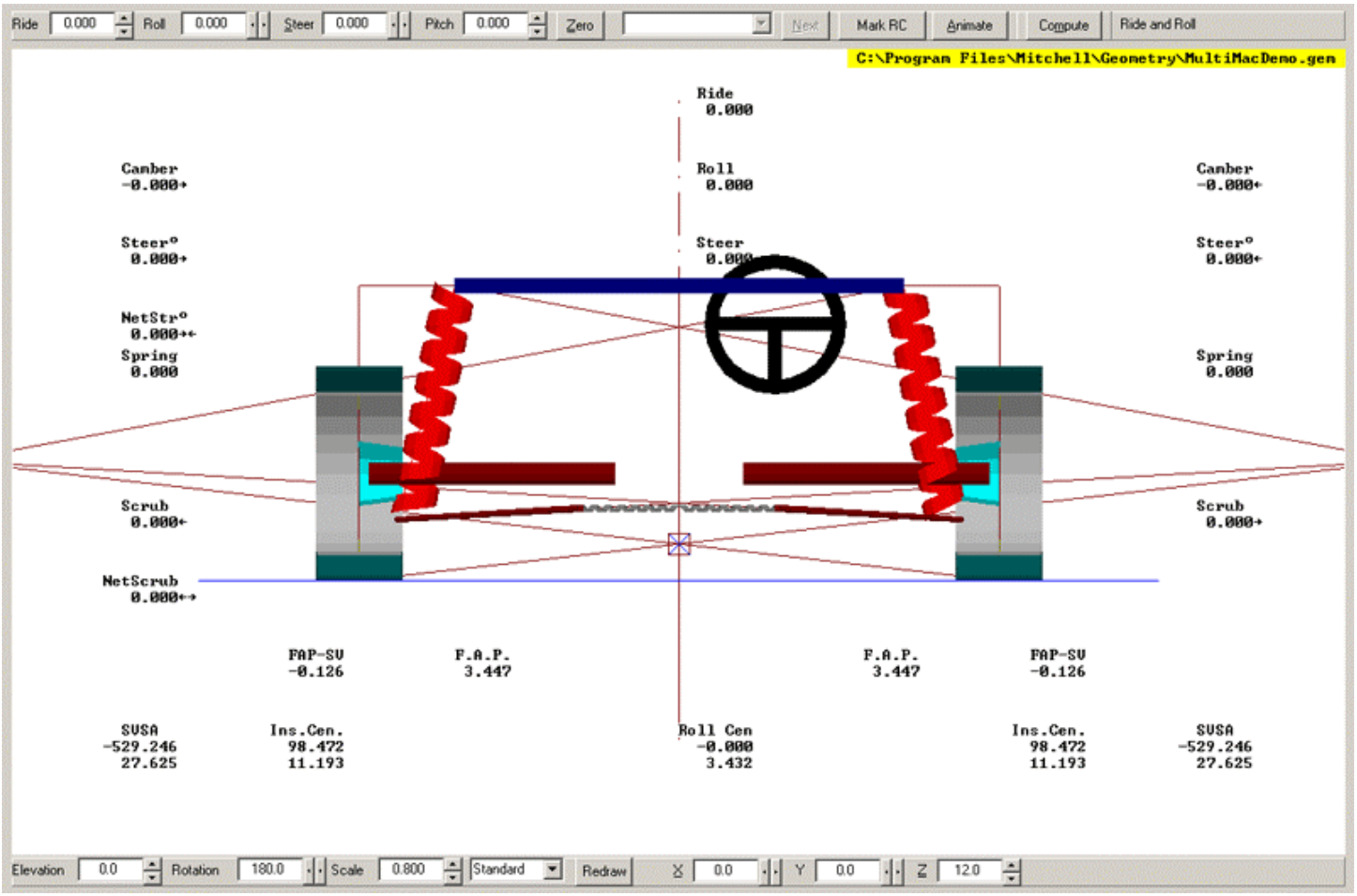


Figure 2

Figure 2 depicts the suspension parameters in Figure 1 with 4.00 deg. of roll. Note that the roll center is above ground and within the front track. The –16.215" tells us that the roll center migrates 16.215" from center under 4.00" deg. of roll while cornering left, and migrates to the inside of the turn.

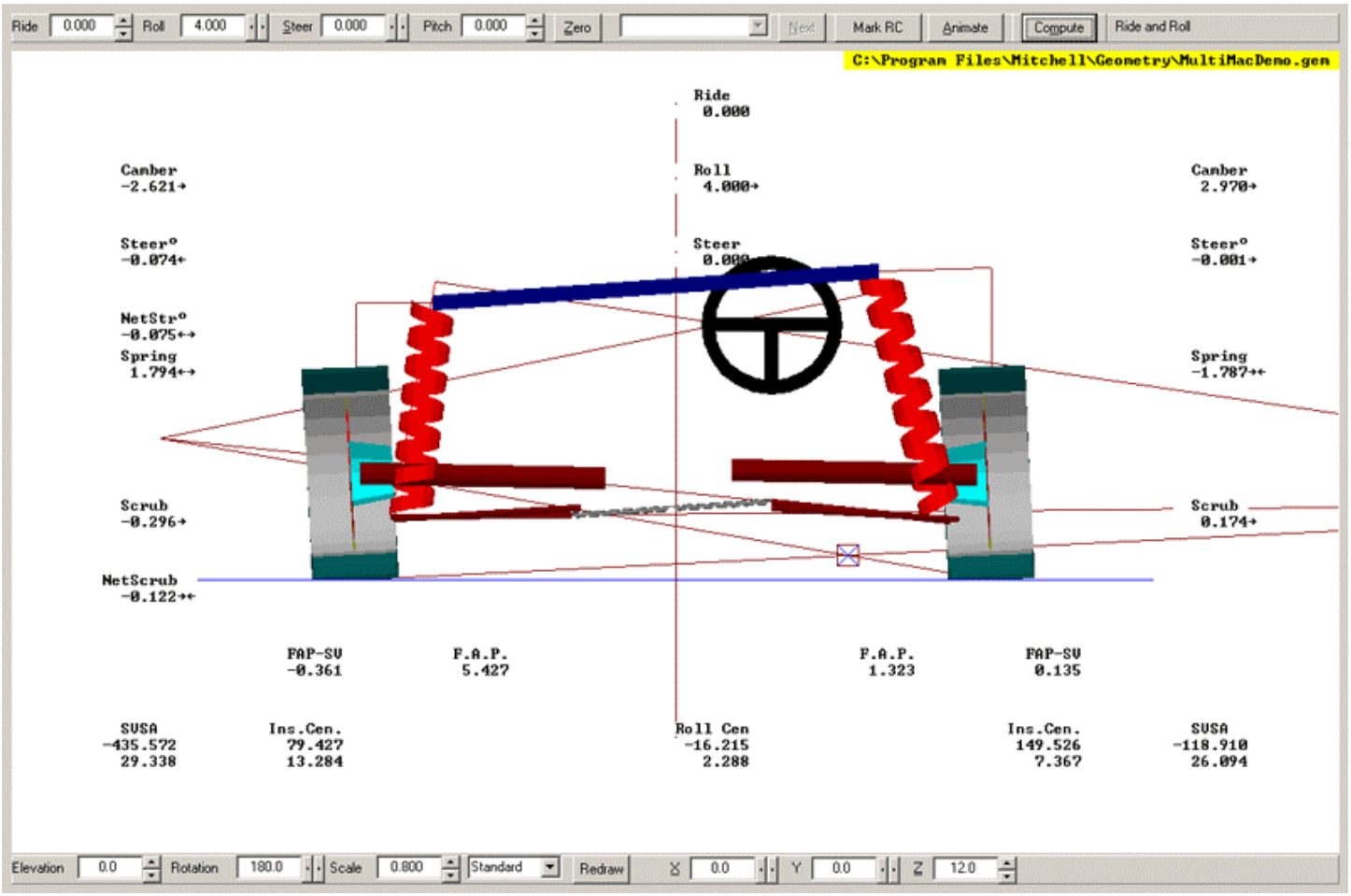


Figure 3

Figure 3 depicts the suspension parameters in Figure 1, with –2.00” of Ride; a lowered ride height of 2”. Note the angles of the lower control arms (LCA); the inner pivot points are lower than the outer pivot points. The roll center height (RCH) is now -.402” (below ground). Our instant centers have shot out to 145”, from 98”.

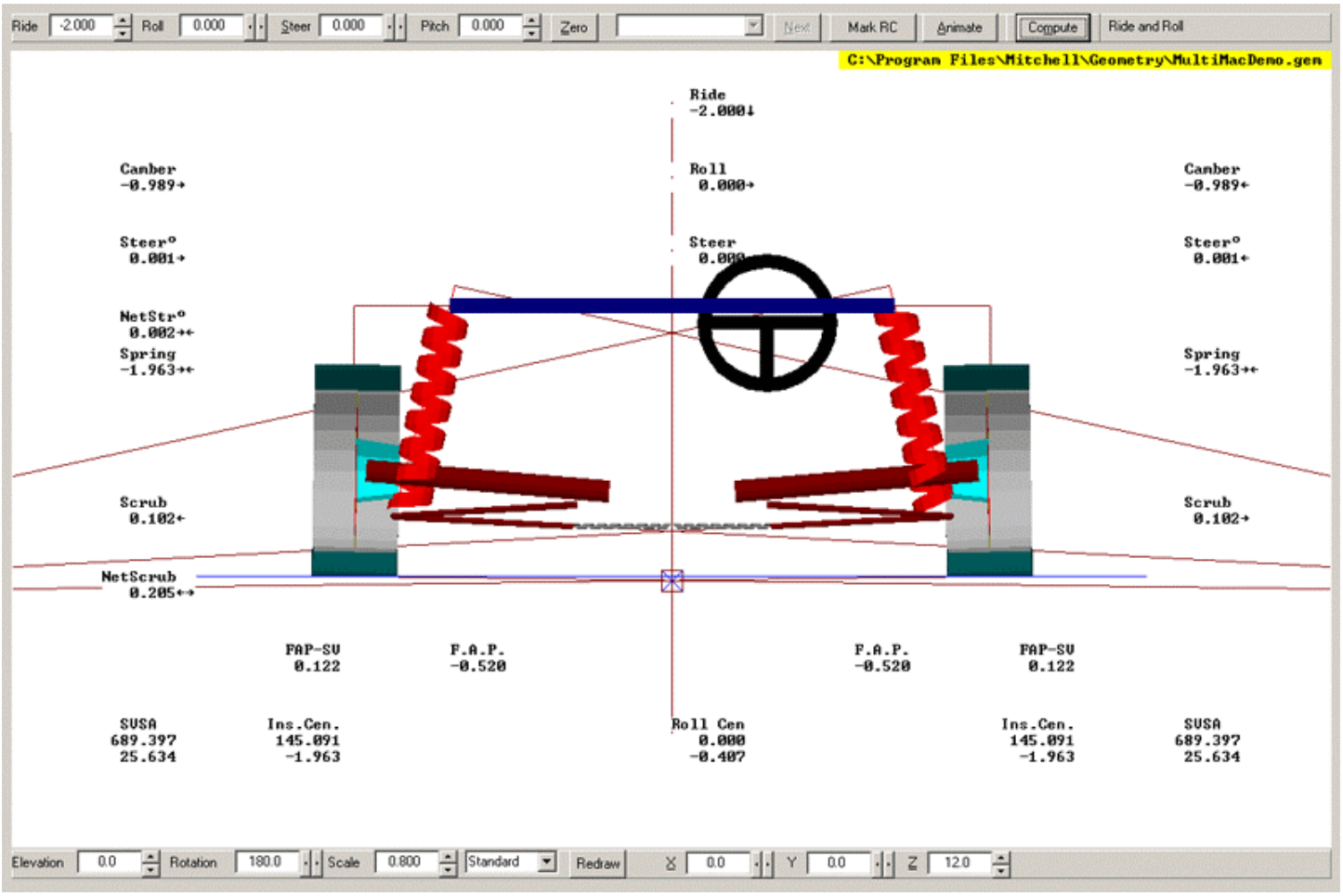


Figure 4

Figure 4 depicts the suspension parameters of Figure 3 with 4.00 deg. of roll. Note that the RCH has migrated above ground (it's off the image to the left), and has migrated 100.149" from the center of the front track, to the left (outside of the turn). Note that prior to lowering in Figure 2, the RC what 16" to the right (inside of the turn).

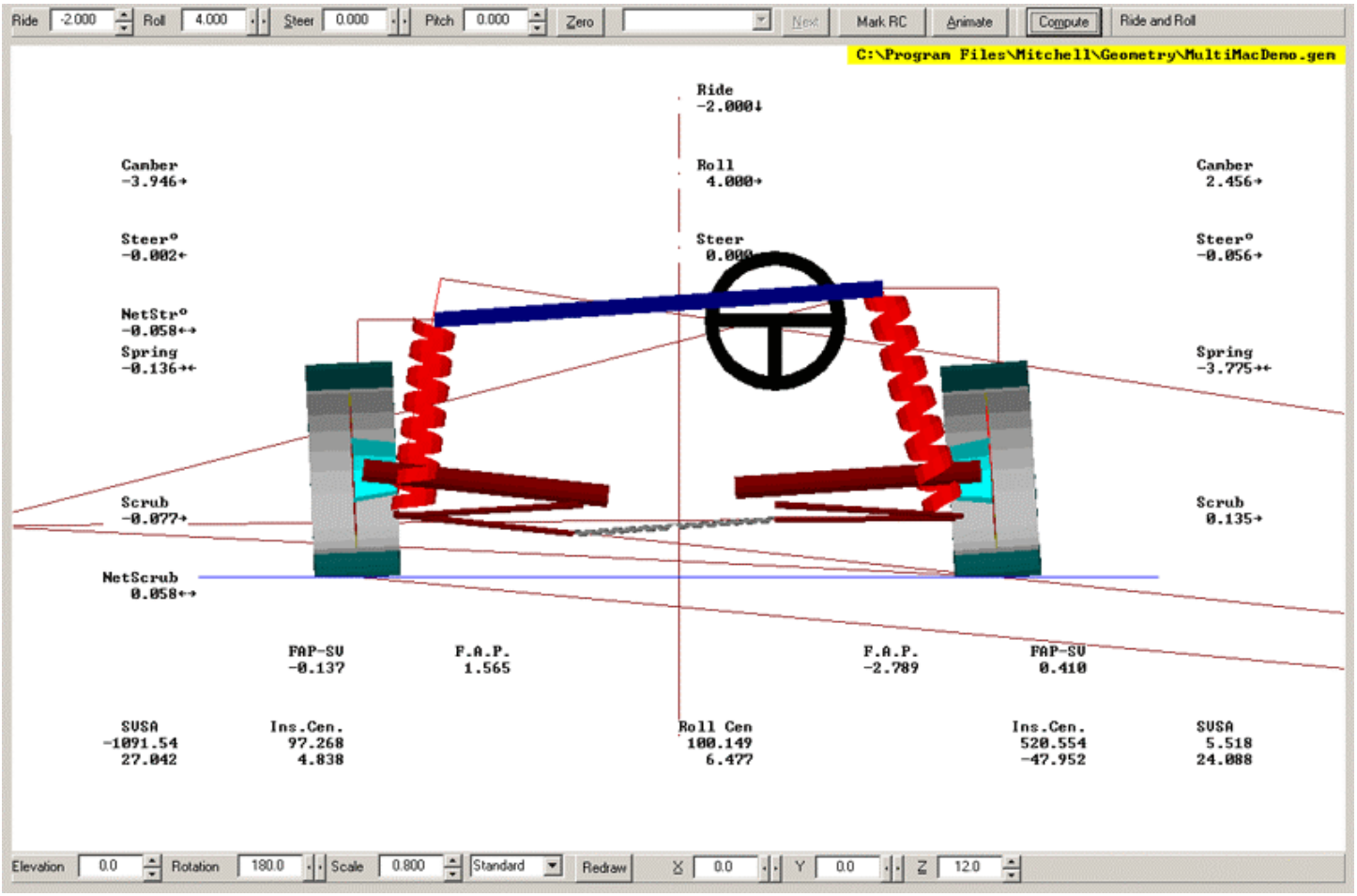


Figure 5

Figure 5 depicts the parameters in Figure 1, but with the upper strut mounting points moved inward 2”, as would happen if you set your camber plates to “full negative”. Note that the RCH is now at 4.000” vs. 3.432”, a gain of 0.568”. Also, our instant centers have shortened roughly from 98” to 74”.

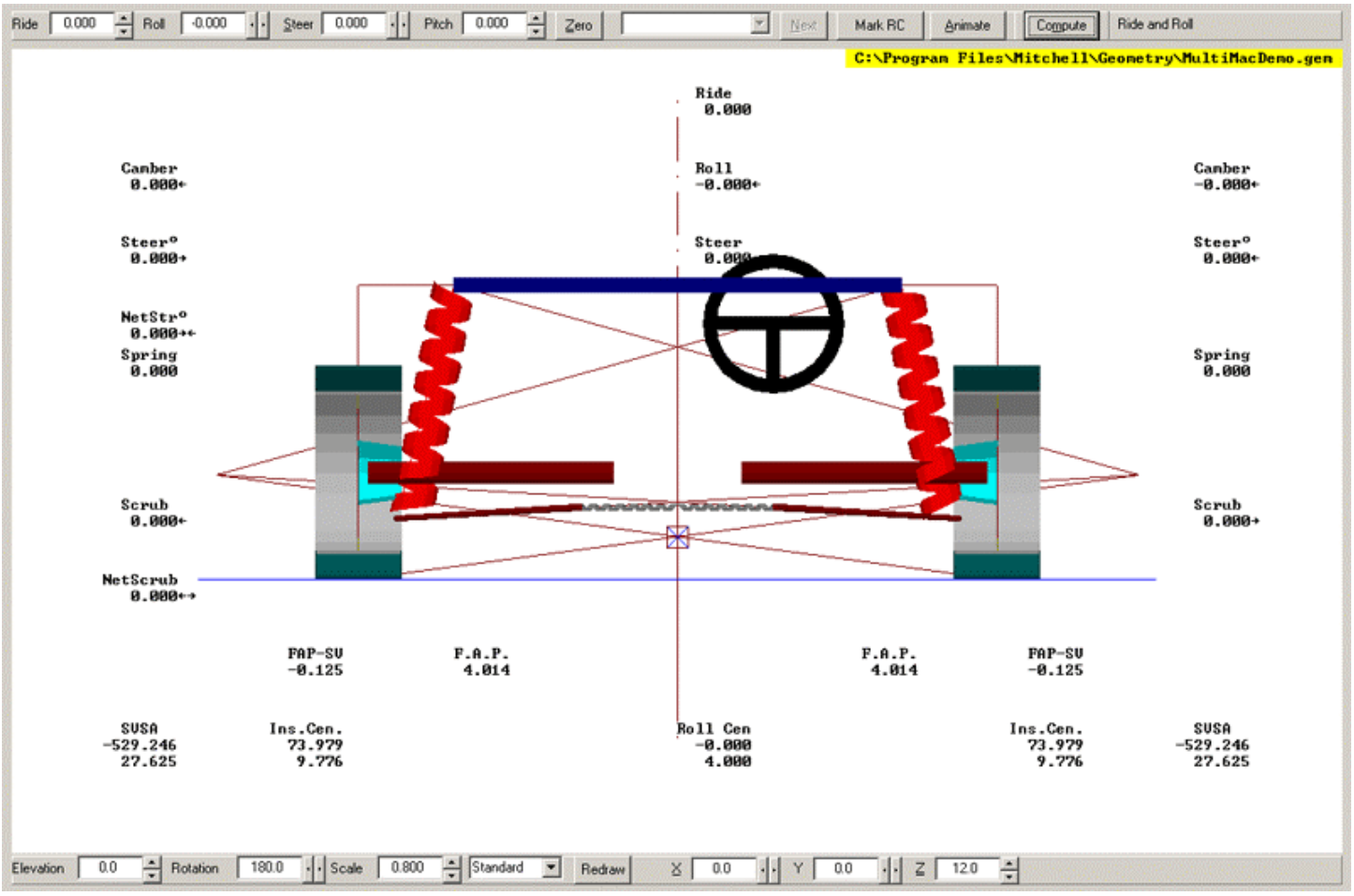


Figure 6

Figure 6 depicts the parameters from Figure 5, with 4.0 deg. of roll. Our RCH dropped to 3.223" and migrated 12.048" to the inside of the turn. When compared to Figure 2, where the strut inclination axis was left alone, the effect of 4.0 deg. of roll on both RCH and lateral migration of RC is reduced.

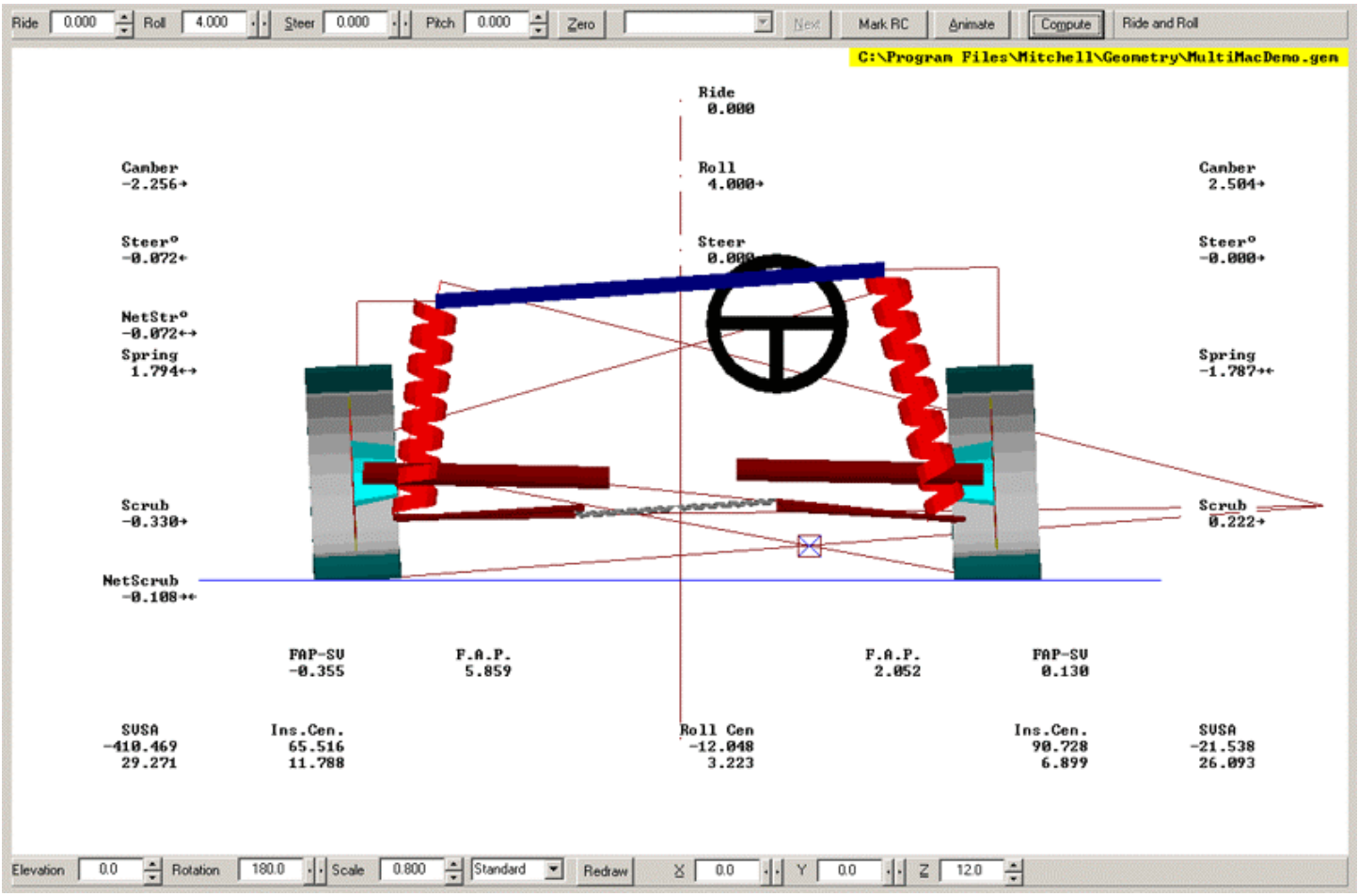


Figure 7

Figure 7 depicts Figure 5 with a 2.0" lowered ride height. So, now we have a lowered ride height and our virtual camber plates set to "full negative". You'll note RCH is now above ground at 0.392", versus what's depicted in Figure 3 where it is .407". That's a change of 0.799" in RCH with the additional strut inclination. Instant centers are also 89", instead of 145".

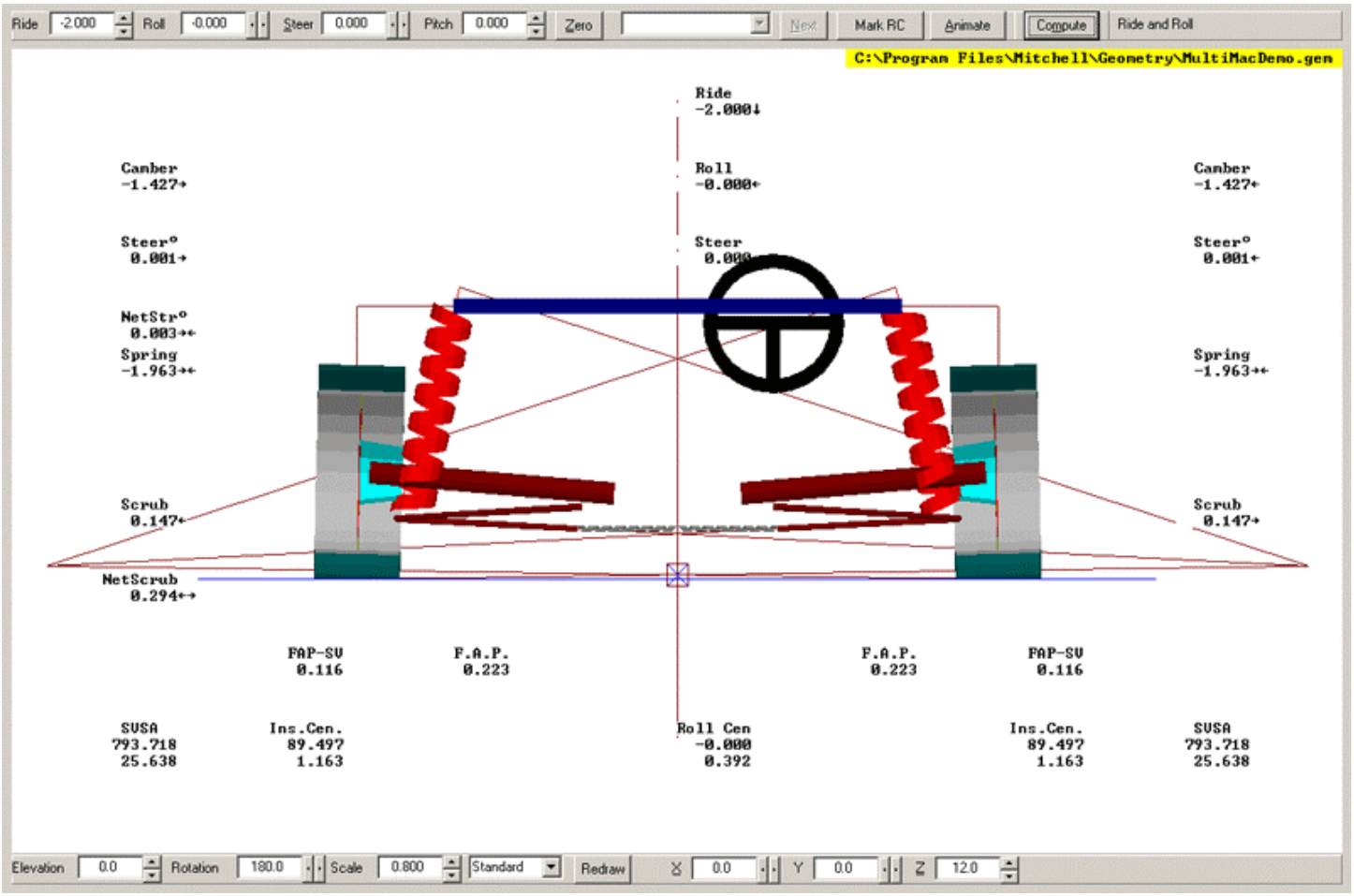
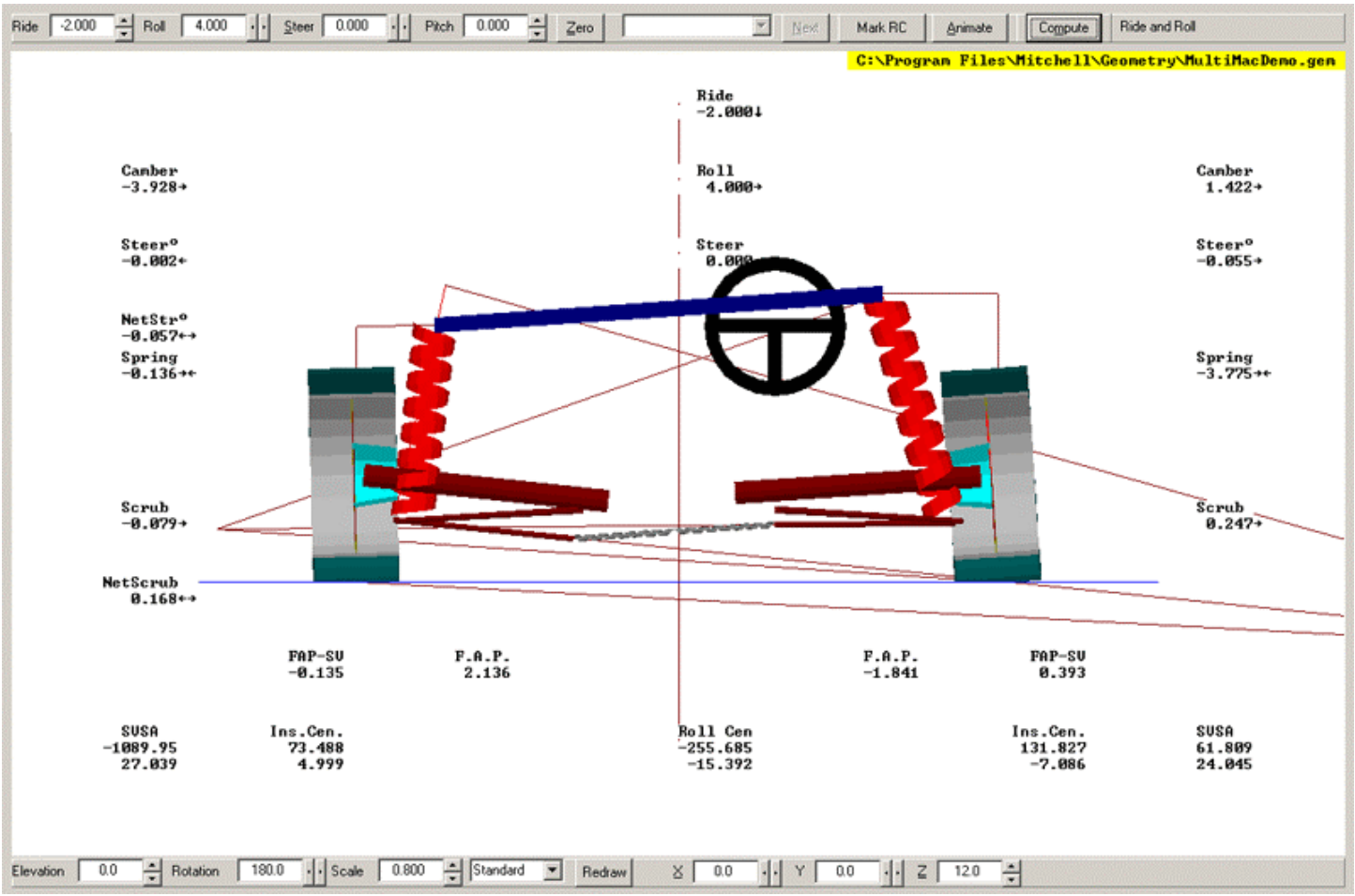


Figure 8

Figure 8 depicts Figure 7 with 4.0 deg. of roll. So, here is a 2" lowered ride height, virtual camber plates set to "full negative", and 4.0 deg. of roll (in a corner). Note the difference in lateral location of RC as compared to Figure 4; it's changed a +100" from the center of the front track on the outside of the turn, to -255" to the inside of the turn. A drastic difference, considering only the strut inclination (camber plate position) has changed. Our RCH is also 15.392" below ground, versus 6.477" above ground in Figure 4.



Conclusions

The conclusions are yours to make and hopefully apply to your benefit for your specific application.