

Rear Roll Steer – Panacea or just more of the same?

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Billy wrote "Consider Chapter 17's Problem 6 in the "Problems, Answers, and Experiments" supplement to the Millikens' RCVD. This problem examines roll steer effects on a skidpad test.

Conclusions include no change in slip angles or final plow/spin characteristics with changes in roll steer. While a skidpad test does not involve transients, it will demonstrate the instability associated with a dynamic effect like critical speed. But, since the slip angles are unaffected by roll steer, no critical speed would ever be encountered. This makes roll steer unique in those items included in an understeer budget.

Transient effects, in corner entry and exit and in overtaking, will...as you indicated...be present IF roll oversteer is sufficiently large. But, as I pointed out with regard to the '57 Chrysler line, a "tad" of roll oversteer can be used as a psychological tool to hide a bad push in a passenger car. "

Milliken doesn't contain much more detail than Billy's summary.

I am mostly concerned with transient behaviour, and like to see similar behaviour throughout the speed range. I suspect we nowadays have cars that are much closer to neutral than the sort of car that Billy is discussing, hence may see effects that he didn't need to worry about.

So, I ran some tests to see whether rear axle roll steer really behaves differently to the usual methods of dialling in, or out, oversteer. The baseline car is quite understeer, and stable to speeds in excess of 350 kph.

The options I chose are using the sta bar balance, which is the commonest solution, changing the tire cornering stiffness, which is often the fastest and neatest solution (adjusting the tire pressures front to rear for example), and the roll steer characteristic of the rear suspension. Then I combined all 3 oversteering actions to produce a car that is somewhere around neutral, called ALL_OS.

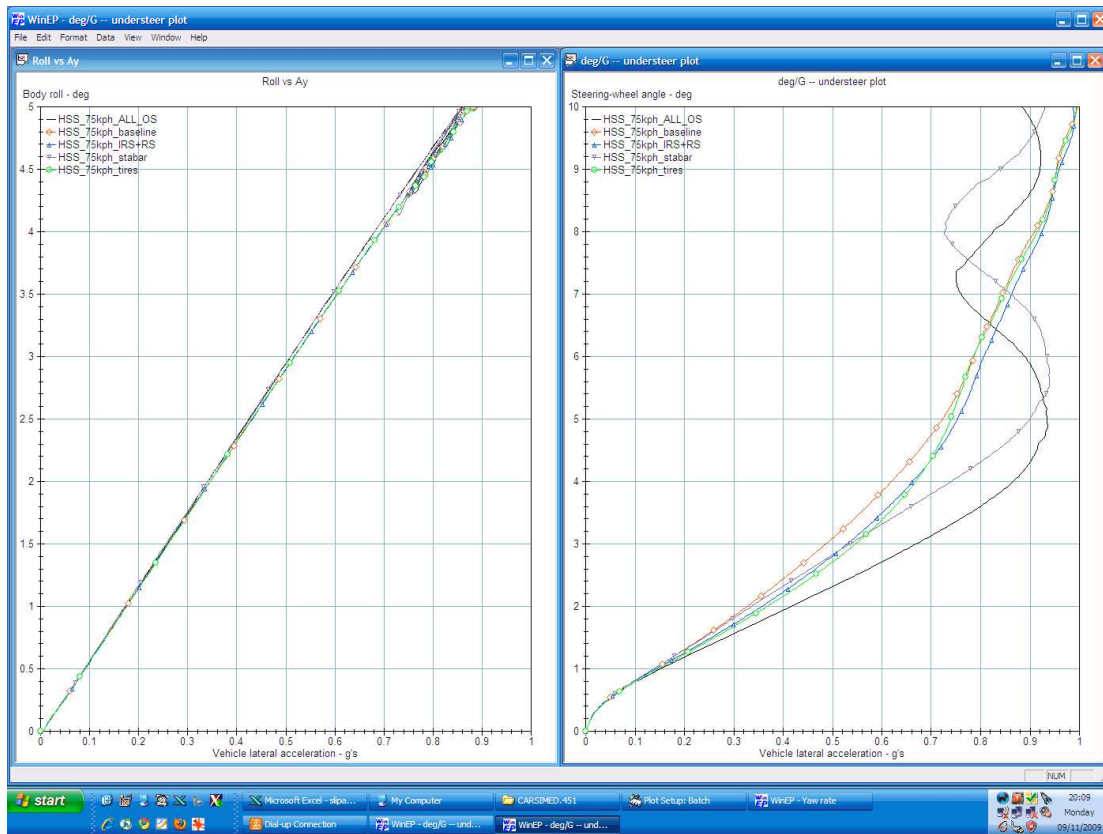
The tire model is relatively crude, giving a fixed cornering stiffness for a given vertical load, capped by a μ of 1. Thus it has most of the characteristics we need for linear range stuff, but runs out of detail at the extremes. This particular curve is a bit odd, but I've seen worse.

Cornering stiffness vs. load (30 pts max)

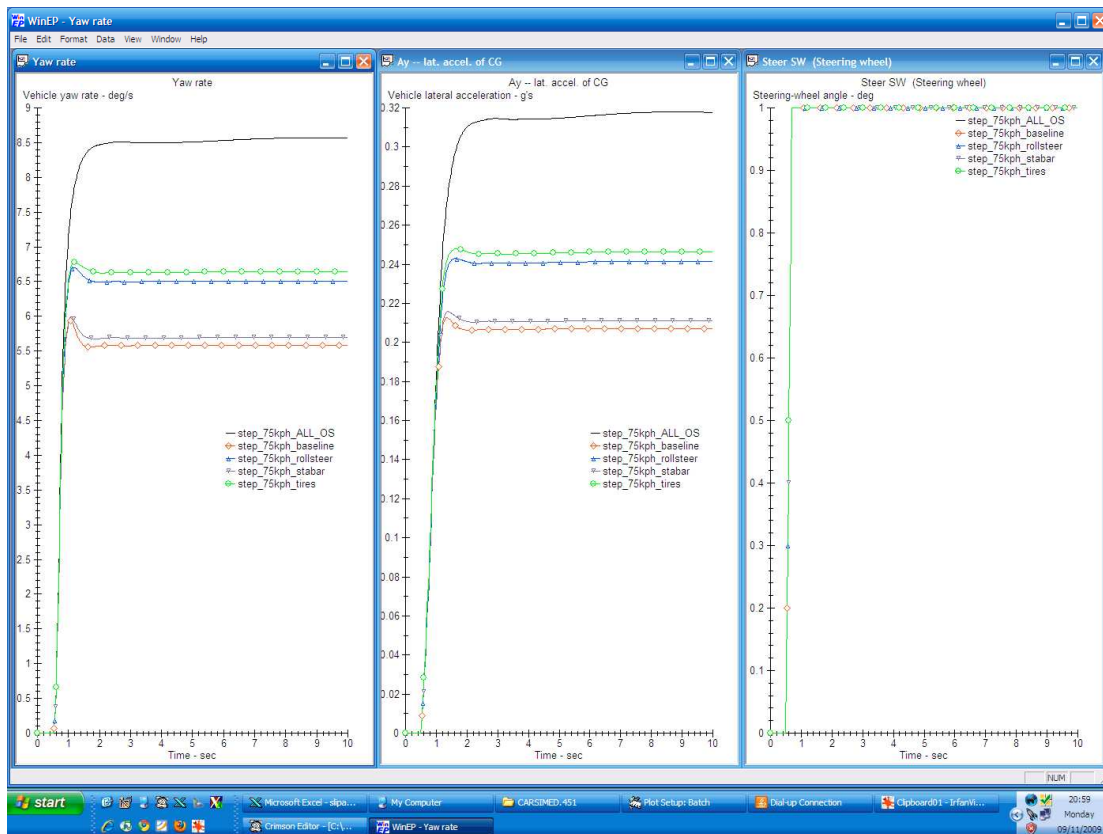
| Fz(N) | Ky (N/deg) |
|-------|------------|
| 0, | 0 |
| 500, | 181 |
| 1000, | 356 |
| 2000, | 673 |
| 3000, | 922 |
| 4000, | 1097 |
| 6000, | 1253 |
| 8000, | 1250 |

The understeer plot for swept steer is a misnomer, as CarSim does not subtract the base steering angle required. The steer ratio is 1, and the wheelbase is 2.7m. Therefore although the ALL_OS run appears to have a fair bit of understeer according to the graph, it isn't. I think its linear range US is 0.27 deg/g. The baseline car is around 2.79 deg/g. The others are 1.97, 1.57, 1.63 respectively.

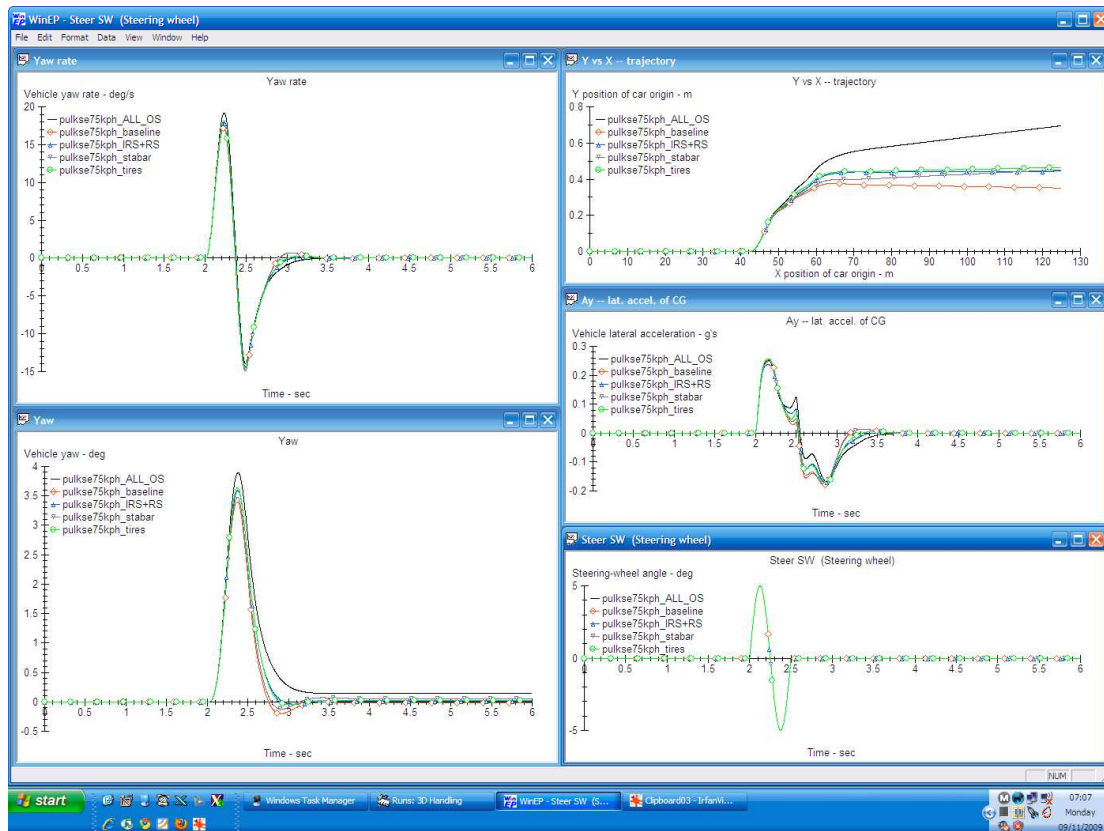
Of the three individual mods the stabar test looks different to the roll steer and tire mods at the limit in the swept steer test at 75 kph, which is roughly equivalent to a skidpad test.



Next test is step steer, at 75 kph. ALL_OS behaves like an oversteering car, with an overdamped response to the same input. The rollsteer and tires are the next, then with stabar and baseline almost the same, with the biggest overshoot.



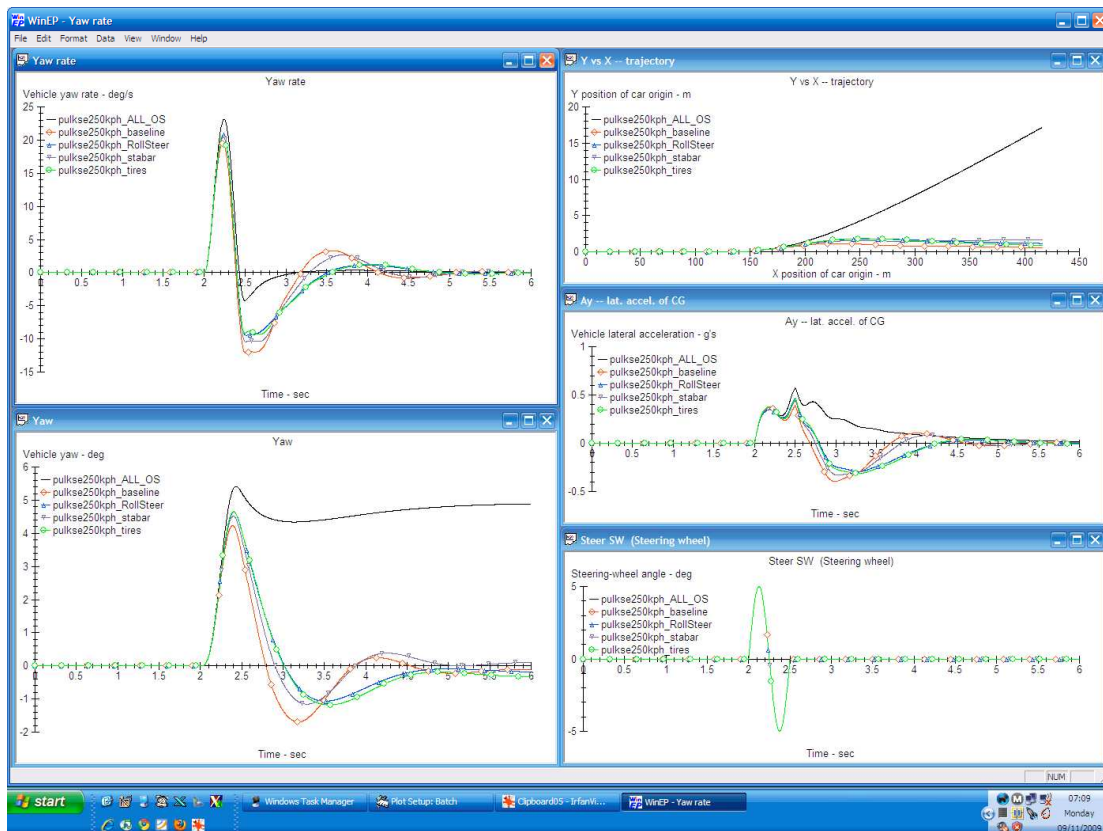
However the real meat, for my purpose, is the pulse steer event, at 75, 150, 250 and 350 kph. At 75 there isn't much in it. At 150 and 250 the stabar is rather different to the other two mods, and ALL_OS progressively ignores the second correction in the steering input.



Then 150 kph



Then 250 kph



Conclusion

Now I reckon that overall there isn't much in it between changing the tires and rear roll steer. Changing the roll balance with the stabars did seem to affect the car in a different way, in fact I think it might have improved the car, which wasn't necessarily in a very good place to start with.