This cross-coupling between suspension movement and cornering roll can have very important implications for stability and control. For example, if the damping is insufficient then the spring compression due to cornering may start a small suspension oscillation as we lean in, this in turn will create varying tyre/road loads altering the relationship between the lateral tyre forces actually produced and those required. This can thus cause cyclic yaw and roll movements, both of which will further add to the tyre force variation. These interactions can get extremely complex and may become self sustaining or worse, actually increase in severity. In practice these effects can manifest themselves as nothing more than a brief damped wobble during corner entry or exit, through undesirable (though ridable) suspension “chopping “, to a fully developed uncontrollable weave resulting in a crash. In any case the varying tyre loads will reduce the ultimate cornering capability to the detriment of racing lap times or road safety.

In the mid 1970s I often used to spend each Wednesday at Brands Hatch either testing or helping other riders sort out their bikes. This was the period when rear suspension struts with damping and ride height adjustment where just coming into common use. Riders were less aware then of how to go about achieving good settings, and it seems that if you give some people adjustability then they’ll manage to arrive at the worst possible setup. It was quite common to see bikes chopping badly on their rear suspension all the way around the bottom bend, and I remember that in countless cases I was able to help cure this just by changing suspension settings.

Figs. 6.?? → 6.?? high-light how reducing only the rear damping can introduce weave motions that show up as variations in most of the dynamic variables. The bike manoeuvre was leaning into a corner from a straight approach with a final lean angle of 44 degrees. This is another example of the integrated nature of motorcycle dynamics, a change in one parameter usually has repercussions throughout the whole machine. For these simulations the rear spring frequency was set lower than the front as this was often a setup that I encountered in practice, when asked to help cure similar problems. The various graph sets cover suspension displacement, tyre forces, lean angle and rear slip angle, which is more or less the yaw angle of the bike. In each case the “wobbly” curve of a pair is the one with the reduced damping. In some parameters there is more variation at the front than the rear, this is due to the effect that the other variables have on the steering angle (not shown).

We can see that not only is there a damped cyclic motion of the suspension as we might expect, but this has cross coupled to a yaw oscillation, tyre force variation and lean angle weave as well. Sometimes there is a very fine line between what is stable and what is not. For the case shown the weave was stable and gradually died away after about six seconds, but if the rear damping was reduced by just a few percent more then the weave would increase rapidly and the simulated motorcycle would crash within two seconds.

This type of instability can also be initiated by hitting a bump when cornering. Frame and wheel flexibility also influences the reaction to such disturbances.

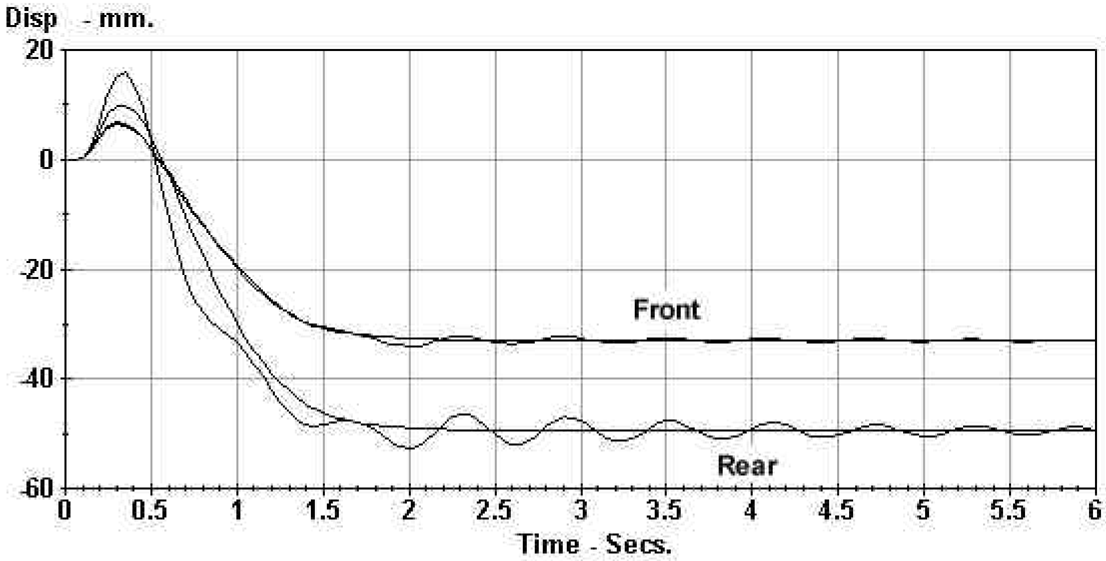

Fig. 6.?? **Front and rear suspension movement, showing the variation in the under-damped case. Note also the suspension extension during the first 0.5 second, this is due to the centrifugal force from the initial build up of roll velocity before the cornering force has overcome it and caused the compression. The damping value also affects the amount of this extension.**

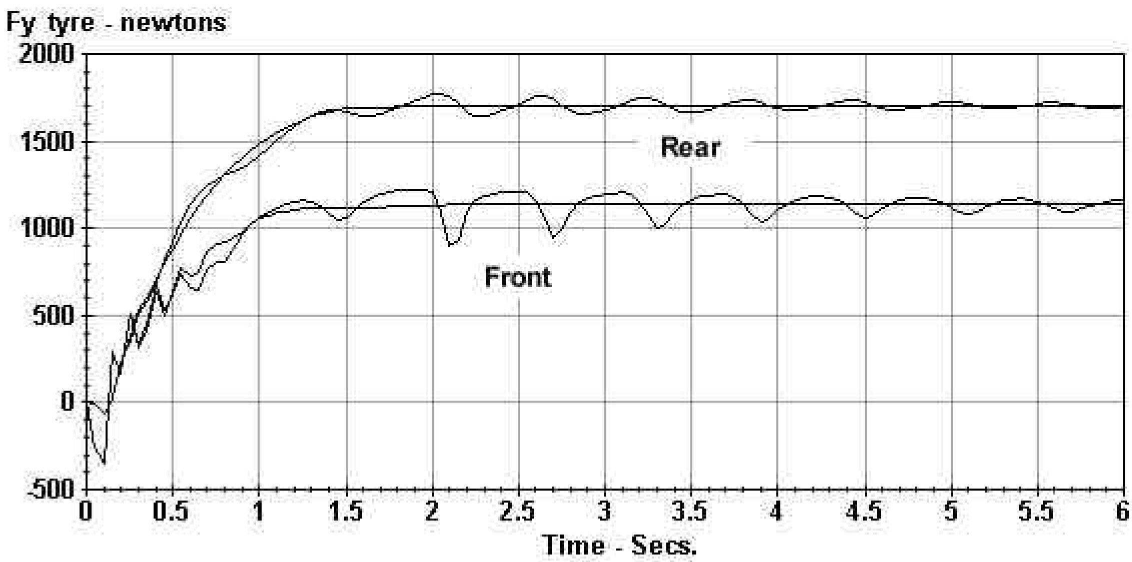

Fig. 6.?? **Lateral tyre forces. Even though it is the rear that is under-damped there is more variation on the front.**