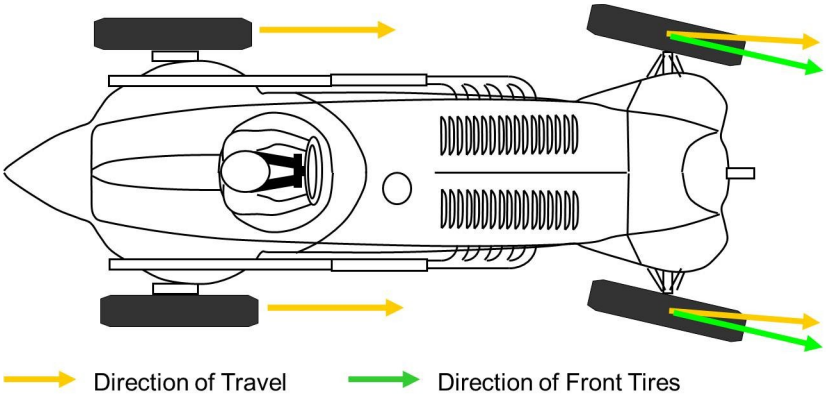


SKID CONTROL

By Ed Valpey

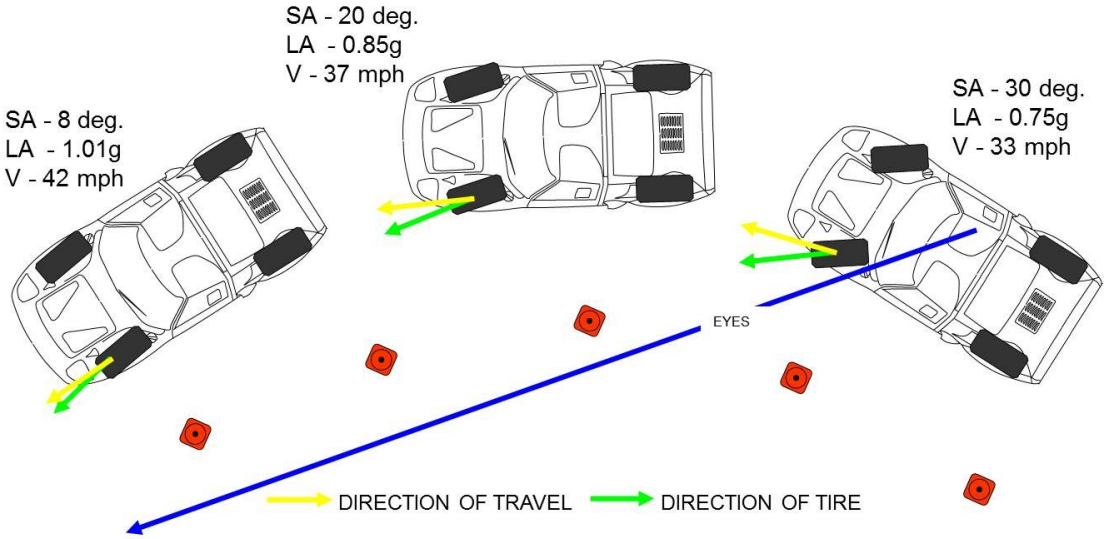
In several of the last few submissions we've talked about "rotating" the car at turn-in to facilitate going to throttle sooner when exiting a corner, and we'll look at this technique in detail in the next submission. Rotating the car means putting it into the very early stages of a spin, so if we're going to suggest that you to get your car started into a spin we should probably spend a little time on how to get you back out of it again.

There are three types of skids, but only one that will easily lead to a spin. It is, of course, the one that leads to a spin that is actually useful. The three types are Front Wheel Skid, Four Wheel Skid and Rear Wheel Skid. These are knuckle-dragger monikers for Understeer, Balanced Slides and Oversteer. The last one is the useful one.

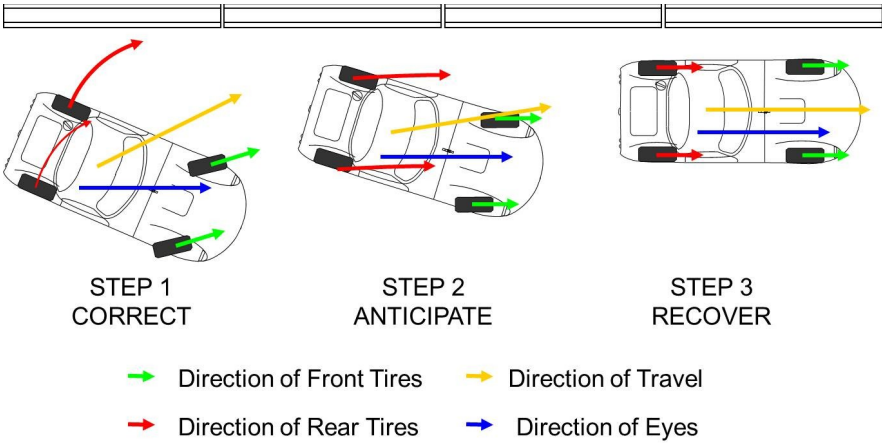
UNDERSTEER

There is never, under any circumstances, a time when understeer is beneficial. Yet if we were to plot a graph of the frequency of the three types of skids understeer would lead the pack by a large margin. Heaven knows we see a lot of it at our schools. Understeer occurs when the front tires are not responding to the steering demands we've placed on them. Automobile engineers are well aware of this and purposely design understeer into every production car out there. The reason is simple: when the average person experiences understeer they crank in even more steering, and when that doesn't work they jump off the gas and go for the brakes. Adding more steering makes matters worse, but lifting off the throttle puts more weight on the front tires and helps them grip better. A little bit of braking can transfer even more weight to the front and further help matters. Unfortunately, people generally slam on the brakes and over-burden the front tires, which results in brake lock-up without ABS and worse turning capability with ABS. On average, however, an understeering car is much safer than an oversteering car.

The illustration at left shows understeer, where the tires are not traveling in the direction they're pointed. The illustration below shows representative changes in performance with varying levels of understeer. S/A is the slip angle of the front tires, LA is the level of grip the front tires are able to generate, and V is the speed that the car is able to achieve while maintaining the same radius.



Correcting understeer is a little like losing weight… at once both simple and difficult. When we experience understeer we must ease off the gas and then do nothing but wait. The latter is the hard part, as our hands will instinctively want to keep trying. In the above illustration, however, we see that turning more makes the front tires grip less. If we've already turned



too much we'll want to actually reduce steering input. I've spent many laps in production cars at 100+ MPH on the South Oval at NHMS telling people to straighten their hands, which is not something they want to hear. Those who manage it, however, discover that the car actually turns better. By eliminating the excessive steering input the tires return to a more optimal slip angle and the car turns better.

BALANCED SLIDES

We really don't need to spend a lot of time on this one. When our car is pointed where we want it to go, but is sliding dramatically sideways, our best option is to do nothing and wait for the tires to regain traction. When it's not pointed in the right direction we have a couple of options. If we need to point the car further into the corner we can lift slightly off the gas, putting a little more weight on the front tires, which helps them to get a little better relative grip. Too much of a lift, however, may cause the car to spin. If we want the car to point out of the corner, and we have proper brake bias and no ABS, we can apply just enough brake pressure to make only the front tires lock. They will slide more and point the car out of the corner. I had to do this once in the corkscrew at Summit Point's Shenandoah course and I hope I never have to do it again. This technique was also used frequently when running the rain line in Lime Rock's Left-Hander before the course was repaved in the early 90s. As cars would hit the polished normal line at the end of the Left-Hander they'd skate sideways – Bruce MacInnes called it the "Slide For Life". Sometimes the slide wasn't balanced, so these techniques, and sometimes a blip of the throttle, were used to insure that car was pointed in the right direction when it regained grip on the other side of the polished line.

OVERSTEER

When dealing with understeer and balanced slides we are generally driving reactively… just as we are, at times, when dealing with oversteer. Better drivers, however, also use oversteer proactively to achieve the aforementioned rotation on corner entry. The illustration at left shows a car in an oversteer condition. The driver has done nothing and the car is spinning around its vertical axis; this is called yaw. In simple terms, the back of the car is trying to pass the front of the car. The more skilled the driver, the sooner he or she will sense yaw and the sooner he or she will react, thus requiring less steering input to correct the slide.

The next illustration shows the steps necessary to correct oversteer. The lines across the top represent an Armco barrier, which is one example of the many things we might call "eye candy". Other examples include guardrails, tire walls, fellow competitors, etc. If we're afraid we might hit something our instincts focus our eyes right on it. Even when there's nothing to hit, most drivers move their eyes either in the direction of the car's travel or in the direction of their hand movements, regardless of whether this is the direction they actually want the car to go. If our eyes are looking at the Armco, that's exactly where we'll end up pointing after we've corrected the slide. We must always remember that we'll steer where we're looking. When an oversteer correction is executed properly, the driver's eyes will never leave his desired direction, shown by the blue arrow

Step 1: **Correct** (also called counter-steering). We want to turn in the direction of the slide, thereby keeping the front of the car in front… rather like balancing a yardstick on the tip of your finger. The degree of steering correction will vary with the severity of the slide. Snap oversteer, which is abrupt and severe, requires extremely fast inputs and hand-over-hand steering is largely regarded as the quickest method of achieving this steering speed. We may even want to "fling" and catch the steering wheel. Simply letting go, however, will not work in a severe slide. Something to keep in mind: If we correct too much, or too quickly, the car will move off line a bit, but it won't spin. If we correct too little, or too slowly, it will spin. It's best to be aggressive with the steering wheel as soon as we detect yaw.

Step 2: **Anticipate**. In this step we're anticipating the rear tires regaining traction. The duration of this step depends on our speed, the severity of the slide and the degree and speed of our correction. It can last a fraction of a second if the slide is mild and our correction is quick, or a number of seconds if we're traveling quickly and our correction is slow and/or inadequate. When we sense that the rear wheels have begun to regain traction, however, we must quickly move on to Step 3.

Step 3: **Recover**. Look again at the car illustration just above Step 1, only imagine that the rear tires have regained traction. The rear tires will now drive the car forward. The front tires are no longer balancing a slide, they're now very aggressively steering the car to the left. Lastly, which isn't illustrated, the initial slide generated a great deal of weight

transfer to the left side of the car. This weight transfer represents potential energy that is stored in the springs, sway-bars, tire side walls, chassis, etc. If the rear tires regain traction with the front tires still turned to the left, this potential energy launches the mass of the vehicle to the right side of the car, providing the right side tires with even more traction to turn the car left. The result is a violent and generally unrecoverable spin in the other direction, called a secondary-reaction spin. It's rare that a driver totally neglects to recover the steering, however. Instead, they merely recover too late, resulting in what we know as a classic tank-slapper. This is why our eyes play such a major role in car control skills. If we're looking at the Armco barrier to the left, our hands will be satisfied to keep turning left. When the scenery starts to go wrong, however, our brain intervenes and commands our hands to turn right. But the damage has been done… our late recovery keeps us off the Armco, but it has set up a tertiary weight transfer that snaps the car back into a spin in the original direction. And so on and so forth until the driver either gets ahead of things, spins or crashes. To prevent this mayhem the driver must be prepared to turn the front tires in the direction he wants the car to go as soon as, or even just before, the rear tires regain traction. If our eyes are looking down the track (where we want to go) our hands will respond immediately to the change in yaw that results from the rear tires regaining traction and they will recover the steering in the right direction. With experience we can anticipate this and recover more smoothly. With even more experience we can throw some throttle into the equation and either sustain the slide (drift), or "soften" the rear tires regaining of traction to allow for a smoother recovery. No matter our level of proficiency, the art of car control, especially when dealing with oversteer, is about 90% eyes.

In the next installment we'll take a look at the proactive use of oversteer, i.e. rotation, for helping us to point the car into the corner and, ultimately, increase exit speed.