DriveSafety Data Collection Variable Definitions

For DriveSafety Vection™ Research Simulators

This document describes the standard set of data collection variables available for use in DriveSafety Vection™ Research Driving Simulators. 48 standard variables are listed with definitions and degree of accuracy. 32 bitfield-defined Digital Input variables are also listed. All 80 variables can be recorded during realtime simulation at up to 60 Hz. The resulting data can be written into flat files appropriate for use in statistical analysis software, spreadsheets and graphing packages.

Unless otherwise indicated, all real values are converted to floating point values to be reported. This means that they contain seven or eight significant digits. As an example of how this affects the reported values, consider a position value. Position values, such as SubjectX, are typically reported with three digits to the right of the decimal, which is one millimeter. If the position value is relatively small, say 987.654, then all of the digits are accurate. However, if the value is very large, say 123,456.789. Then, the digits are only guaranteed to be accurate to 123,456.7.

The following is the current alphabetical list of TCL variables:

- Accel -(default) The normalized accelerator input value. The value ranges from 0.000 to 1.000. A value of 0.000 means the accelerator pedal is not being depressed. A value of 1.000 means that the accelerator pedal is at the maximum depression. The values contain three digits to the right of the decimal. This value is a 10 bit number, which means it is accurate to 0.001.
- ActiveTrigger - (default) The name of one trigger that was activated by the subject this frame. It will be '-' if no triggers were activated. NOTE: This value is only guaranteed to be accurate if data is being collected at 60 Hz.
- Brake -(default) The normalized brake input value. The value ranges from 0.000 to 1.000. A value of 0.000 means the brake pedal is not being depressed. A value of 1.000 means that the brake pedal is at the maximum depression. The values contain three digits to the right of the decimal. This value is a 10 bit number, which means it is accurate to 0.001.
- Collision - (default) The name of the object with which the subject is colliding this frame. It will be '-' if there is no collision.
- CollisionAngle - The collision angle indicates which portion of the subject vehicle was involved in the collision. The value is in degrees and ranges from 0.0 to 359.9 degrees. A value of 0.0 degrees indicates that the collision was at the front center of the subject vehicle. A value of 90.0 degrees indicates that the collision was at the right center of the vehicle (the passenger side of the vehicle). The collision angle at the point of impact, (i.e. the first frame that the collision is reported) is usually the most useful.

- CollisionVelocity - The relative speed in m/s at which the subject and other object collided. This is calculated by adding the portion of the speeds of both the subject and the other object that are in the direction of the collision. The direction of the collision is determined as a straight line connecting the center of each object. The portion of the speed that is in the direction of the collision is determined by the cosine of the angle between the heading of the vehicle and the straight line between the centers of the two objects multiplied by the speed of that vehicle. The sum of these partial speeds is the value returned. A positive value means that the center of the subject vehicle and the center of the other object are getting closer together. A negative value means that the centers are getting farther apart. Typically, collisions start with a positive collision speed and progress to a negative speed as the objects are separating. The collision speed is reported with three digits to the right of the decimal, but all calculations are done in double precision.

- CultureType - The culture type assigned to the tile on which the subject vehicle is currently located. The culture type includes "Rural", "Urban", "Residential", etc.

- DigitalInputs - Digital inputs from the BUC or cab this frame. All of the inputs are combined into this value and DigitialInputs2, with one digit indicating the state of each input. For example, the rightmost digit will be a 1 if the ignition is in the run position and a 0 if it is not. Following is a list of all the digital inputs and the digit that is set for that input:

DIN_IGNITION_RUN	0000000000000001	(Bit 0, String Index 15)
DIN_IGNITION_START	0000000000000010	(Bit 1, String Index 14)
DIN_LIGHTS_PARK	0000000000000100	(Bit 2, String Index 13)
DIN_LIGHTS_HIGHBEAM	0000000000001000	(Bit 3, String Index 12)
DIN_LIGHTS_ON	0000000000010000	(Bit 4, String Index 11)
DIN_LEFT_TURN	0000000000100000	(Bit 5, String Index 10)
DIN_RIGHT_TURN	0000000001000000	(Bit 6, String Index 9)
DIN_HORN	0000000010000000	(Bit 7, String Index 8)
DIN_ESTOP	0000000100000000	(Bit 8, String Index 7)
DIN_CAB_POWER	0000001000000000	(Bit 9, String Index 6)
DIN_HAZARD	0000010000000000	(Bit 10, String Index 5)
DIN_MISC_0	0000100000000000	(Bit 11, String Index 4)
DIN_MISC_1	0001000000000000	(Bit 12, String Index 3)
DIN_MISC_2	0010000000000000	(Bit 13, String Index 2)
DIN_MISC_3	0100000000000000	(Bit 14, String Index 1)
DIN_MISC_4	1000000000000000	(Bit 15, String Index 0)

To use this variable in a script, use the string index given above, and code similar to the following:

if { [string index $DigitalInputs 15] == 1 } {SimOutputMessage "The ignition is in the RUN position"}
Some research BUCs have other specialty buttons that may be wired to the MISC bits. Refer to the procedure below to determine their bit index.

If using a PC steering wheel (USB or Joyport) the inputs will be different than those described above. In this case, there will be one bit for each button on the wheel/stick (in DigitalInputs and potentially DigitalInputs2). Create a script that outputs $DigitalInputs in a virtual trigger, press each button in sequence, and examine the log file to determine the button to bitfield mapping for your device.

- DigitalInputs2 - Additional digital inputs from the BUC or cab this frame. See further description in DigitalInputs.

DIN_BUTTON_A	0000000000000001	(Bit 0, String Index 15)
DIN_BUTTON_B	0000000000000010	(Bit 1, String Index 14)
DIN_BUTTON_C	0000000000000100	(Bit 2, String Index 13)
DIN_BUTTON_D	0000000000001000	(Bit 3, String Index 12)
DIN_PARKING_BRAKE	0000000000010000	(Bit 4, String Index 11)
DIN_SAFETY_BELT	0000000000100000	(Bit 5, String Index 10)
DIN_SPARE_0	0000000001000000	(Bit 6, String Index 9)
DIN_SPARE_1	0000000010000000	(Bit 7, String Index 8)
DIN_SPARE_2	0000000100000000	(Bit 8, String Index 7)
DIN_SPARE_3	0000001000000000	(Bit 9, String Index 6)
DIN_LEFT_MIRROR	0000010000000000	(Bit 10, String Index 5)
DIN_RIGHT_MIRROR	0000100000000000	(Bit 11, String Index 4)
DIN_REAR_MIRROR	0000110000000000	(Bits 10&11, String Index 4&5)
DIN_MIRROR_MASK	0000110000000000	(Bits 10&11, String Index 4&5)
DIN_MIRROR_LEFT	0001000000000000	(Bit 12, String Index 3)
DIN_MIRROR_RIGHT	0010000000000000	(Bit 13, String Index 2)
DIN_MIRROR_UP	0100000000000000	(Bit 14, String Index 1)
DIN_MIRROR_DOWN	1000000000000000	(Bit 15, String Index 0)

To use this variable in a script, use the string index given above, and code similar to the following:

if { [string index $DigitalInputs2 0] == 1 } {SimOutputMessage "You managed to press button A"}

Note that most research BUCs do not have the inputs described above. Some research BUCs have other specialty buttons. Refer to the procedure below to determine what their bit index is.

If using a PC steering wheel (USB or Joyport) the inputs will be different than those described above. In this case, there will be one bit for each button on the wheel/stick (in DigitalInputs and potentially DigitalInputs2). Create a script that outputs $DigitalInputs2 in a virtual trigger, press each button in sequence, and examine the log file to determine the button to bitfield mapping for your device.

- DistToEntity - The straight-line distance in meters to the monitorEntity. This distance does not follow the roadway, and therefore will be valid even when off-road. This distance uses the size of the subject, but not the size of the monitorEntity. The distance is calculated as the 3D distance from the center of the subject to the center of the other object minus the front bumper distance of the subject vehicle. This value is reported with three digits to the right of the decimal.
- EntityAccel - The forward acceleration of the monitorEntity in meters per second squared. This value is reported with three digits to the right of the decimal.
- EntityHeading - The heading of the monitorEntity. Heading ranges from 0.000 to 359.999 degrees. A value of 0.000 is straight north. Values increase in a clockwise manner, such that 90 degrees is east, etc.
- EntityName - The name of entity currently being "monitored". This variable, as well as the other variables dealing with the monitorEntity, will be '-' if no monitorEntity has been set (via SimCollectData or SimSetMonitorEntity).
- EntityVelocity - The forward speed of the monitorEntity in m/s. This value is reported with three digits to the right of the decimal.
- FreeLook - The freelook angle in degrees. This value is not active on most research BUCs.
- Frame - An integer counter that is incremented once per simulation frame (currently every 16.666 ms or 60 Hz).
- Gear - The gear that the subject is using this frame: P, R, N, D, 2 or 1.
- HeadwayDist - The distance in meters from the subject's front bumper to the rear bumper of the vehicle ahead. This distance follows the roadway and therefore includes the distance around curves. The roadway distance is determined as the sum of the straight-line distances between each pair of consecutive points along the roadway. This value is reported with three digits to the right of the decimal.
- HeadwayTime - The time in seconds to the vehicle ahead. This value is calculated as HeadwayDist divided by subject speed. This value is reported with three digits to the right of the decimal. Also see TTC.
- Horn - The state of the horn. This state will be 'T' if the horn is being activated or 'F' if it is not being activated.

- LaneCount - The integer number of lanes on the subject's current path that are in the same direction of flow as the lane in which the subject vehicle is travelling.
- LaneHeading - The heading in degrees of the lane at the point where the subject vehicle is currently located. Heading ranges from 0.000 to 359.999 degrees. A value of 0.000 is straight north. Values increase in a clockwise manner, such that 90 degrees is east, etc.
- LaneIndex - The number of the lane in which the subject is travelling. The lanes are numbered with positive values, starting at 1 and increasing outward, for the lanes flowing in the same direction as the subject. The on-coming lanes have negative values starting at -1 and decreasing outward. Turn lanes are indicated with LT (left turn) or RT (right turn) prefacing a number where 1 is the leftmost turn lane. The same positive/negative scheme applies. Other special codes are SH for shoulder, SH- for shoulder facing against the flow, PL for parking lot, OF for offroad, and 0 for unknown.
- LaneName - The "internal" name for the lane in which the subject is located. Ex: Inter1t0-1, Inter23t4-0, etc. The first part of the lane name is the name of the intersection or tile as assigned in the authoring tool. In the previous example the names of the intersections are Inter1t and Inter23t. This variable may be used to determine when the subject has changed lanes, or when the subject is in a particular intersection, etc.
- LanePos -(default) The lane offset in meters within the current lane. It will be '-' if the subject is not in a lane. Positive is to the right, negative is to the left. This value is reported with three digits to the right of the decimal.
- LatAccel -(default) The latitudinal component for the acceleration of the subject vehicle. The lateral and longitudinal acceleration are the total acceleration of the vehicle with respect to inertial coordinates expressed in the local frame, i.e. this is the acceleration that would be measured by an accelerometer in the vehicle, except that gravity is not included (gravity would also be measured by an accelerometer). This value is reported with three digits to the right of the decimal.
- LongAccel - (default) The longitudinal component for the acceleration of the subject vehicle. The lateral and longitudinal acceleration are the total acceleration of the vehicle with respect to inertial coordinates expressed in the local frame, i.e. this is the acceleration that would be measured by an accelerometer in the vehicle, except that gravity is not included (gravity would also be measured by an accelerometer). This value is reported with three digits to the right of the decimal.
- ProjectName - A 64 character string identifying the project.
- Signal - The state of the turn signal. This state will be 'L' if the left blinker is on, 'R' if the right blinker is on, 'H' if the hazard lights are on, or '-' when neither blinker is active.

- Slip - A true ("T") or false ("F") value indicating whether or not there is tire slippage. A true value indicates that the normalized wheel slip value for the front left tire is greater than 0.6 and that the subject is travelling faster than 0.1 m/s. The wheel slip value is the total slip calculated in the tire model. This is calculated as sqrt(longSlip*longSlip + latSlip*latSlip). The longSlip is longitudinal slip which is calculated as (wheel angular speed * wheel radius - longitudinal ground speed)/longitudinal ground speed. The latSlip is the lateral slip which is calculated as atan(lateral ground speed/longitudinal ground speed).
- SpeedLimit - The speed limit of the lane in which the subject is currently located. It will be '-' if the subject is not in a lane. SpeedLimit is expressed in m/s and is reported with three digits to the right of the decimal.
- Steer -(default) The steering input value in degrees. CW is positive. A steering wheel can make three complete revolutions, with each revolution containing 360 degrees. Starting at the rest position (0 degrees), the steering wheel can turn one and one half revolutions to the right (+540 degrees) and the same to the left (-540 degrees). The steering value is reported with one digit to the right of the decimal (i.e. tenths of a degree).
- SubjectEngineRPM - The subject vehicle's engine rpm is the actual engine speed in revolutions per minute (as you would see on your tachometer). This is the actual engine speed calculated in the vehicle and used to predict engine power and transmission force.
- SubjectHeading - (default) The subject vehicle's current heading in degrees. Heading ranges from 0.000 to 359.999 degrees. A value of 0.000 is straight north. Values increase in a clockwise manner, such that 90 degrees is east, etc.
- SubjectID - A 32 character string identifying the subject.
- SubjectName - A 64 character string containing the name of the subject, as it was input.
- SubjectPitch - The subject vehicle's current pitch in degrees. Pitch ranges from -180.000 to 180.000 degrees. Pitch values are positive when the vehicle is pitching upward, such that the front tires are higher than the back tires.
- SubjectRoll - The subject vehicle's current roll in degrees. Roll ranges from -180.000 to 180.000 degrees. Roll values are positive when the vehicle is rolling to the right, such that the left tires are higher than the right tires.
- SubjectX - (default) The subject vehicle's current X position in meters. This value is reported with three digits to the right of the decimal.
- SubjectY - (default) The subject vehicle's current Y position in meters. This value is reported with three digits to the right of the decimal.

- SubjectZ - The subject vehicle's current Z position in meters. This value is reported with three digits to the right of the decimal.
- TerrainType - An internal string for the name of the roughest terrain on which any of the subject's tires are located.
- Time - The time in seconds since the start of this exercise. This value is reported with five digits to the right of the decimal.
- TimeToEntity - The time in seconds to collision with the monitorEntity. This is determined by using the portion of the speeds of both vehicles that is in the direction of a collision. This value is calculated as DistToEntity divided by the sum of the subject's speed toward the monitor entity + that entity's speed toward the subject. The portion of the speed that is in the direction of the collision is determined by the cosine of the angle between the vehicle's heading and the straight line between the centers of the two objects multiplied by the vehicle's speed.
- TTC - (Time To Collision) - The time in seconds to collision with the vehicle ahead. This value is calculated using the speed of both the subject and the VehAhead. See also HeadwayTime. This value is calculated as HeadwayDist divided by the difference between the subject's speed and the speed of the lead vehicle. If the lead vehicle is driving faster than the subject vehicle, a collision will not occur, so this value is reported as the default '-'.
- UserData - For backwards compatibility, this value can be used to access the first user data field. This field is a string of up to 32 characters that is set with the command SimSetUserData.
- VehAhead - The name of the closest vehicle in front of the subject which is also in the same lane as the subject. If no vehicle is within a reasonable distance, this variable and the related variables will be '-'.
- Velocity - (default) The speed of the subject vehicle in m/s. This value is reported with three digits to the right of the decimal.
- ViewMod - The view modifiers (free look, etc.) that are being activated this frame. All of the modifiers are combined into this one value. Currently the least significant digit will be a 1 if freelook is activated and a 0 if it is not activated. Likewise, the next three digits indicate whether each of the other buttons are pressed. This value is not active on most research BUCs.
- ZoneName - The name of the currently active data collection zone (trigger name). It will be '-' if data collection is not active.