### Accuracy and Timing of 2013 Ford Flex Event Data Recorders 2014-01-0504

Richard R. Ruth, P.E. – Ruth Consulting LLC Jeremy S. Daily, P.E., Ph.D. – University of Tulsa

#### Purpose

- The Autoliv RC6 family of EDR's in the 2010-14 Flex was the first to record Stability Control System Inputs at 0.1 second intervals.
- The testing measures and reports the accuracy of these new data elements, in addition to the usual speed data and evaluation of reporting time delays.

#### Two Step Test Process

- Drive 2013/4 Flex in steady state, hard braking, figure 8 and yaw conditions. Record VBOX speed and all vehicle CAN bus traffic on VECTOR data acquisition system. Compare VBOX speed to CAN bus speed.
- Go to laboratory. Mount ACM onto computer controlled linear sled. Replay CAN bus data from driving as the sled creates recordable events. Compare EDR data to CAN data and reference instrumentation.



Accelerometer mounted on test ACM and its Delta V used to synchronize with Delta V in CDR report.







#### CAN Speed - Filtered GPS Difference in km/h



# Note truncation to whole km/h rounded to mph

#### Pre-Crash Data -5 to 0 sec [2 samples/sec] (Second Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)
- 5.0	48 [78]	18.0	Off	1,460	non-engaged
- 4.5	48 [78]	15.3	Off	1,462	non-engaged
- 4.0	48 [78]	15.3	Off	1,464	non-engaged
- 3.5	48 [78]	15.3	Off	1,466	non-engaged
- 3.0	48 [78]	0.0	Off	1,468	non-engaged
- 2.5	48 [77]	0.0	On	1,426	non-engaged
- 2.0	35 [56]	0.0	On	1,124	engaged
- 1.5	29 [46]	0.0	On	936	engaged
- 1.0	18 [29]	0.0	On	808	engaged
- 0.5	11 [17]	0.0	On	626	engaged
0.0	0 [0]	0.0	On	548	engaged





ACM was dithered to create stability control system input

#### EDR Speed vs CAN vs VBOX



CAN Bus speed and EDR reported speed versus GPS speed during hard braking from 113 km/h.



#### Min Time Delay CAN -> EDR: <0.1 Seconds



### Max Time Delay CAN -> EDR: <0.5 seconds



## Stability Control System Longitudinal Accel



#### GPS Acceleration vs. CAN Longitudinal Accel



### Yaw Rate CAN vs GPS in Figure 8

Note: CAN yaw rate was inverted



# CAN Bus Yaw Rate vs. reference instruments (entire fixture rotated)



#### GPS Lateral Accel vs. Stability 2 (Figure 8)



19

#### Steering Wheel Can Bus Output vs. Input



### EDR Steering Data vs. CAN Bus Steering data



#### Summary and Conclusions

- CAN bus reported steady state speed data lower than reference instrumentation by an average of -1.26 km/h with a range of -0.6 to -1.8 km/h.
- When the speed is truncated for reporting in the EDR, the difference to reference instrumentation becomes more negative to an average of -1.9 km/h (1.2mph) difference to GPS with a range of -0.8 to -2.9 km/h (-0.5 to -1.8 mph).
- Well within the +/-4% widely accepted as EDR speed accuracy
- Hard Braking Speed Data A time delay of 0.0 to 0.5 seconds is possible

### Summary and Conclusions 2

- Yaw Rate Vehicle CAN bus Yaw rate closely tracks GPS calculated yaw rate.
- Longitudinal Acceleration-The EDR longitudinal acceleration closely tracked a dithering +/0.5G input on the stroker fixture
- Steering Angle Actual steering angle magnitude closely tracked CAN bus reported steering angle.

### Contact Information

- Richard R. Ruth, P.E. <u>ruthconsulting@comcast.net</u>
- Jeremy S. Daily, P.E., Ph.D.

jeremy-daily@utulsa.edu