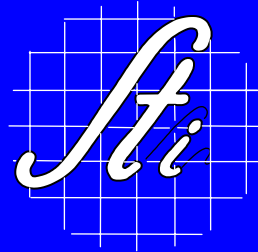


CURRENT ACTIVITIES AT SYSTEMS TECHNOLOGY, INC.



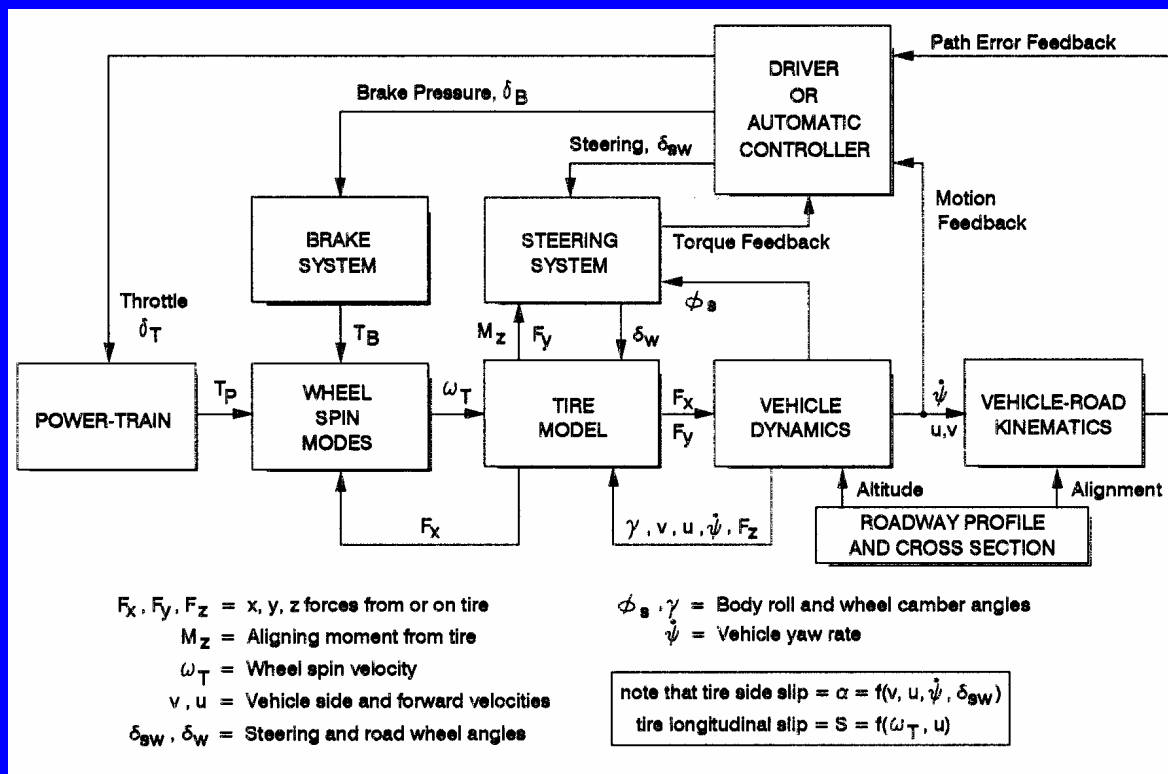
David H. Klyde
dklyde@systemstech.com

SAE Aerospace Control & Guidance Systems Committee
Meeting No. 97

Lake Tahoe, NV
1-3 March 2006

IMPROVING AND VALIDATING VDANL (Ground Vehicle Computer Simulation)

- STI has recently made a number of improvements to VDANL under a contract for the U.S. Army (TACOM)
- STI has also been able to validate many of the improvements by developing and evaluating a heavy truck model for the FHWA (sub-contract to Battelle)



IMPROVEMENTS TO VDANL

- Enhanced tire model with asymptotic fits of tire data
- Multi-axle vehicles and trailers – previously limited to 2 axles, now up to 10
- Multiple wheels/tires per axle side
- Brake thermal model
- Enhanced bump stop model
- Damper/bump stop track widths
- Speed sensitive steering power assist model

VALIDATION OF TRACTOR/TRAILER VDANL MODEL

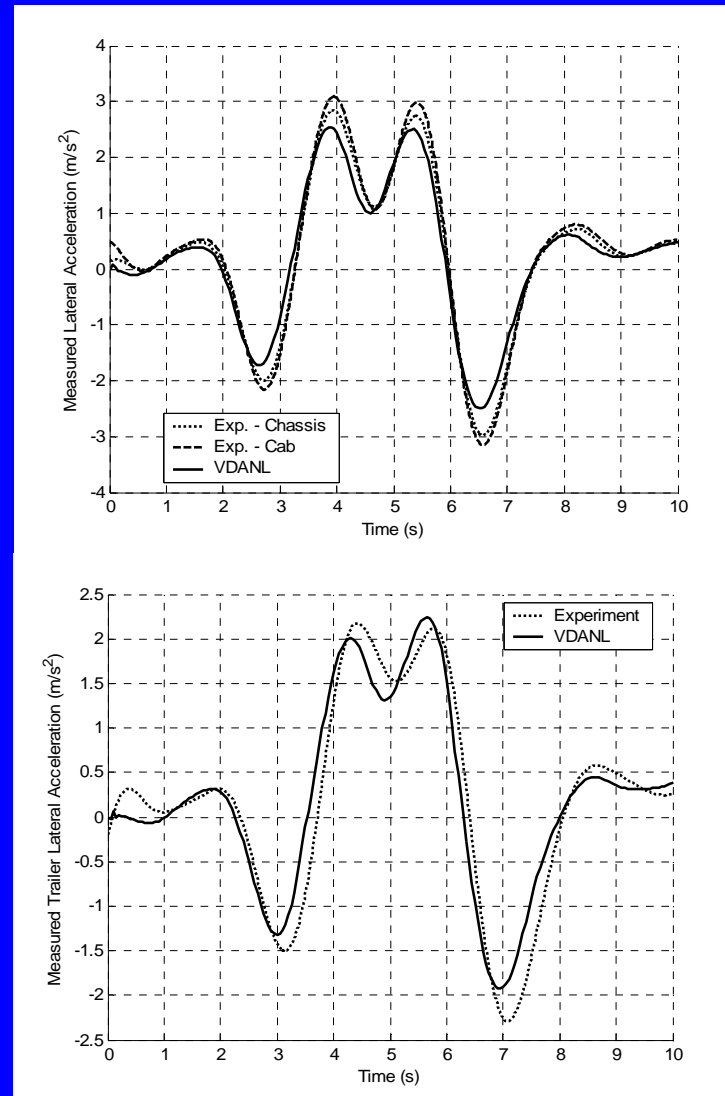
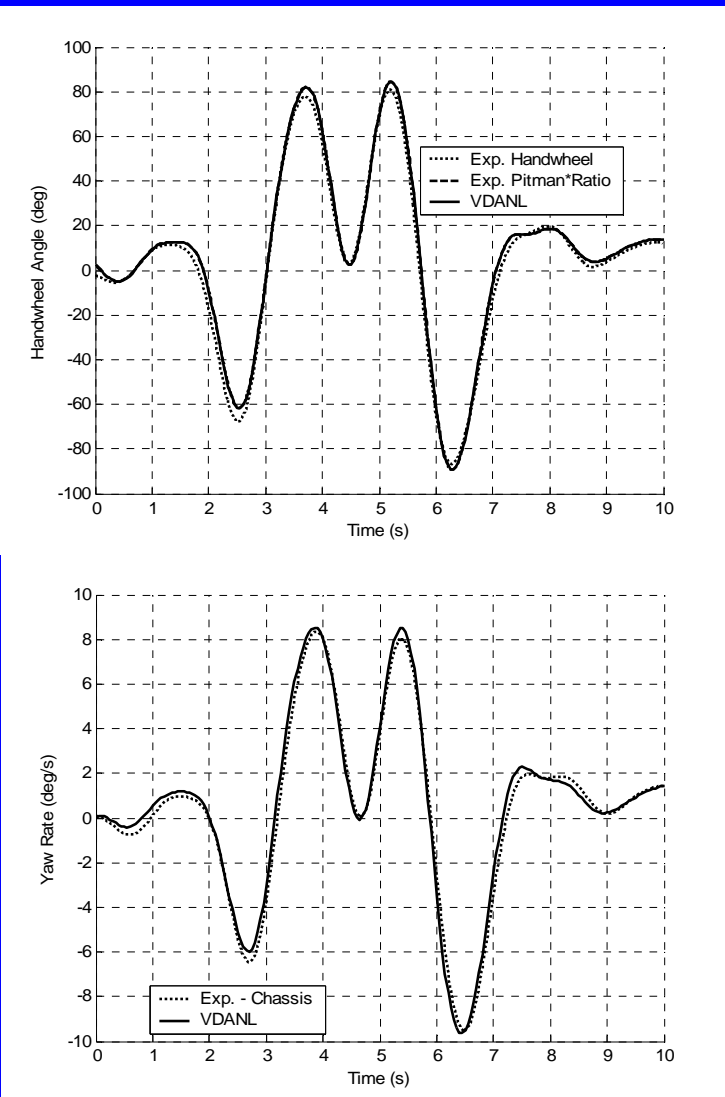
- Parameter set developed for a tractor/semi-trailer combination
- The modeled vehicle was previously fully instrumented and tested at NHTSA's Vehicle Research and Test Center (VRTC)
- The validation included comparisons to the test data for a wide range of maneuvers:
 - Slowly Increasing Steer
 - Step Steer
 - Straight Line Acceleration
 - Straight Line Braking
 - Lane Change
- The VDANL results were also compared to results of an evaluation of the NADSdyna software which is used in the National Advanced Driving Simulator
- The VDANL results were found to be similar to those for the NADSdyna software

VRTC TEST VEHICLE: (92 Volvo GMC Model WIA64T & 92 Fruehauf Trailer)



Note: Photos are representative of test vehicle

LANE CHANGE RESULTS

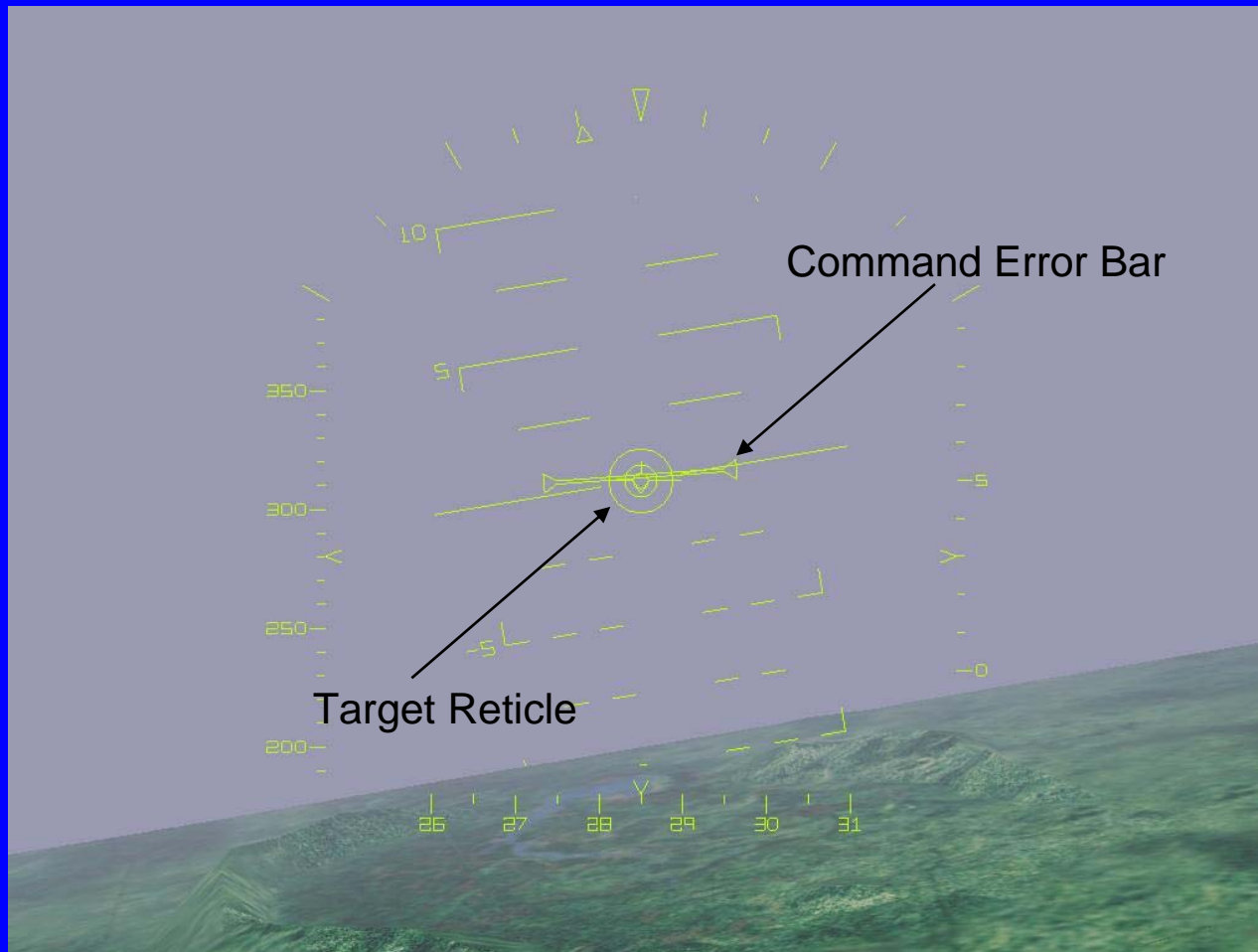


STI RESEARCH FLIGHT SIMULATOR WITH MCFADDEN CONTROL LOADER

- PC-Based Simulator (Linear Aircraft Dynamics with Nonlinear Control System Elements)
- Vehicle dynamics that update at 120 Hz and graphics that update at a minimum of 60 Hz
- Texture-mapped PC graphics with a superimposed head-up display that supports pitch and roll axis tracking tasks



SIMULATED SCENE WITH PROJECTED HUD

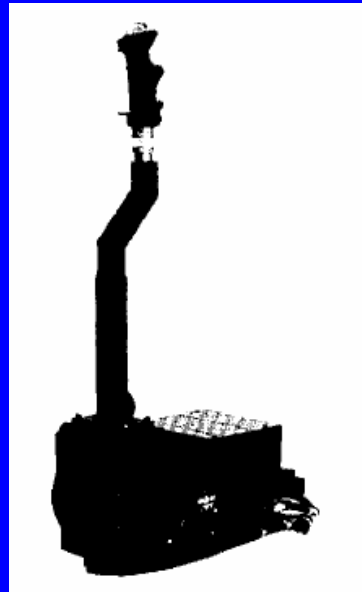


1-3 March 06

Presentation to SAE Control & Guidance
Systems Committee

CONTROL LOADER DESCRIPTION

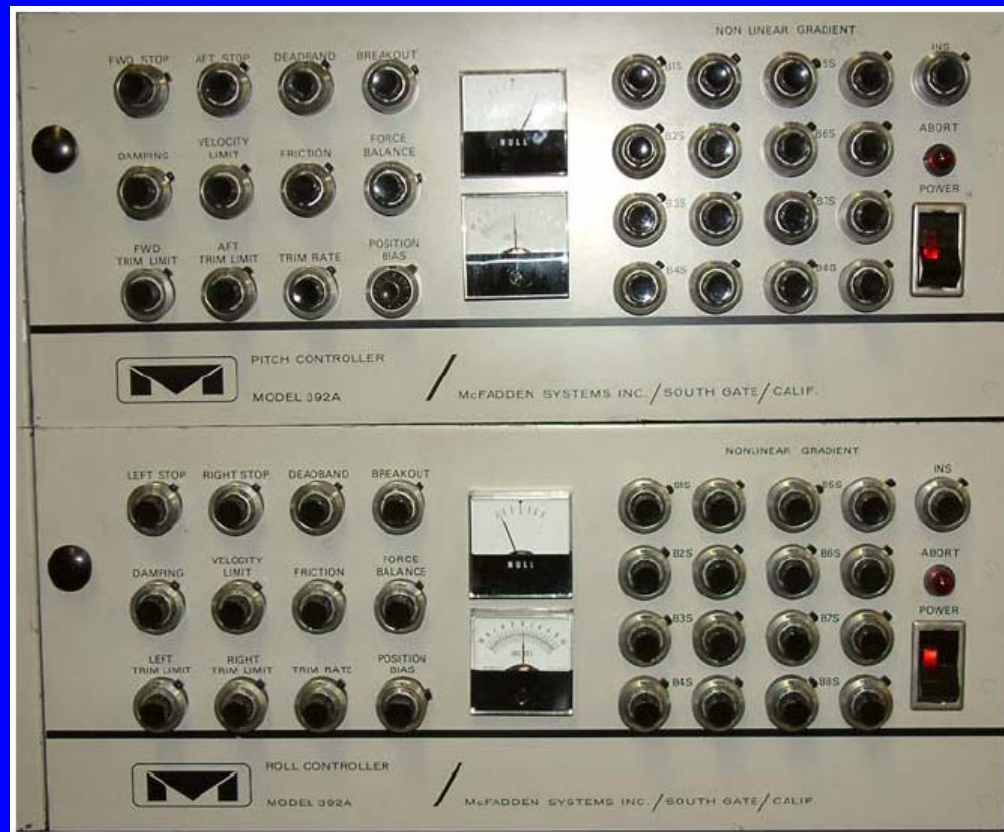
- McFadden Series 292A Pitch & Roll Stick
- Dimensions are Representative of F/A-18 Hornet Centerstick
- Maximum Force Output Exceeds 100 lbs
- Force Threshold < 0.1 lb
- Maximum Velocity – 50 in/sec
- Frequency Response (Force Loop) Exceeds 40 Hz



Hydraulic Power Supply

PITCH & ROLL AXIS VARIABLE FEEL SYSTEM CAPABILITIES

- Spring Gradients
- Travel Limits
- Breakout Force
- Position Bias
- Force Balance
- Velocity Limit
- Friction
- Damping
- Deadband



SIMULATOR APPLICATIONS

- Phase II SBIR for NASA Dryden
 - Use of control stick force feedback cueing to alleviate pilot-vehicle system loss of control
 - NASA COTR: Tim Cox
- Potential Future Applications
 - Evaluation of on-line system identification schemes using a simulated flight test environment (i.e., pilot input types, evaluation tasks, etc.)
 - Evaluation of control stick force feedback cueing in conjunction with existing rate limiting alleviation schemes and PIO suppression filter concepts