

F 15 Aerodynamic data built from vspaero; AeroDatum (10.23, 0, 0.26)M, 2019-10-29 14:21

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AeroDetail=Full, WakeIterations=2

Compared against windtunnel data **F-15 Aerodynamic data from (AFIT/GAE/ENY/90D-16); CG 25.65%**

Model summary

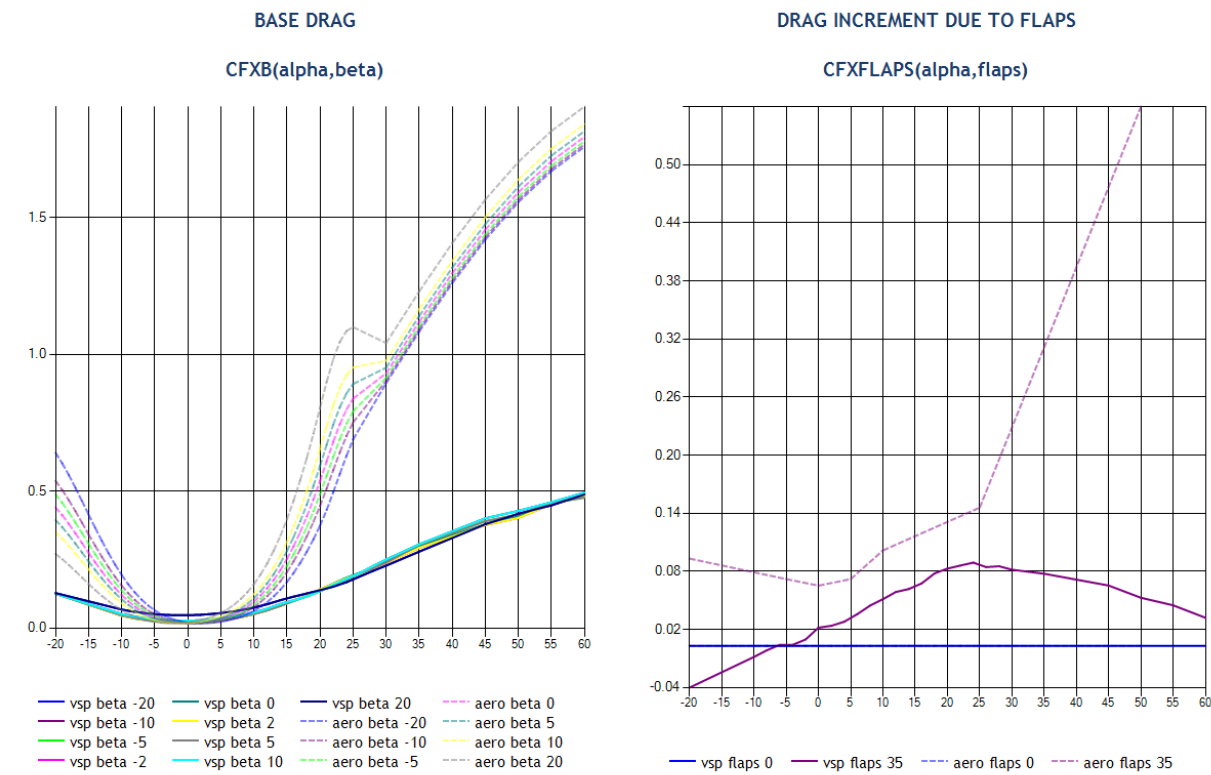
Dependent variable	Independent variables	Axis	Description
CFXB	alpha,beta	DRAG	BASE DRAG
CFXFLAPS	alpha,flaps	DRAG	DRAG INCREMENT DUE TO FLAPS
CFZB	alpha,elevator	LIFT	BASE LIFT
CFZFLAPS	alpha,flaps	LIFT	LIFT INCREMENT DUE TO FLAPS
CMM1	alpha,elevator	PITCH	BASE PITCHING MOMENT
CMMQ	alpha	PITCH	PITCH DAMPING DERIVATIVE
CMMFLAPS	alpha,beta	PITCH	PITCHING MOMENT INCREMENT DUE TO FLAPS
CML1	alpha,beta	ROLL	BASE ROLLING MOMENT
CMLDTD	alpha,elevator	ROLL	PITCH MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION - CLDD
CMLP	alpha	ROLL	ROLL DAMPING DERIVATIVE
CMLDAD	alpha,beta	ROLL	ROLLING MOMENT DUE TO AILERON DEFLECTION
CMLDRD	alpha,beta	ROLL	ROLLING MOMENT DUE TO RUDDER DEFLECTION
CMLR	alpha	ROLL	ROLLING MOMENT DUE TO YAW RATE
CFYB	alpha,beta,elevator	SIDE	BASE SIDEFORCE
CYDAD	alpha,beta	SIDE	SIDE FORCE DUE TO AILERON DEFLECTION
CFYDTD	alpha,elevator	SIDE	SIDE FORCE DUE TO DIFFERENTIAL TAIL DEFLECTION - CYDTD
CFYP	alpha	SIDE	SIDE FORCE DUE TO ROLL RATE
CYDRD	alpha,beta	SIDE	SIDE FORCE DUE TO RUDDER DEFLECTION
CFYR	alpha	SIDE	SIDE FORCE DUE TO YAW RATE
CMN1	alpha,beta,elevator	YAW	BASE YAWING MOMENT
CMNR	alpha	YAW	YAW DAMPING DERIVATIVE
CMNP	alpha	YAW	YAW MOMENT DUE TO ROLL RATE
CMNDAD	alpha,beta	YAW	YAWING MOMENT DUE TO AILERON DEFLECTION
CMNDTD	alpha,elevator	YAW	YAWING MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION
CMNDRD	alpha,beta	YAW	YAWING MOMENT DUE TO RUDDER DEFLECTION

Coefficient Buildup

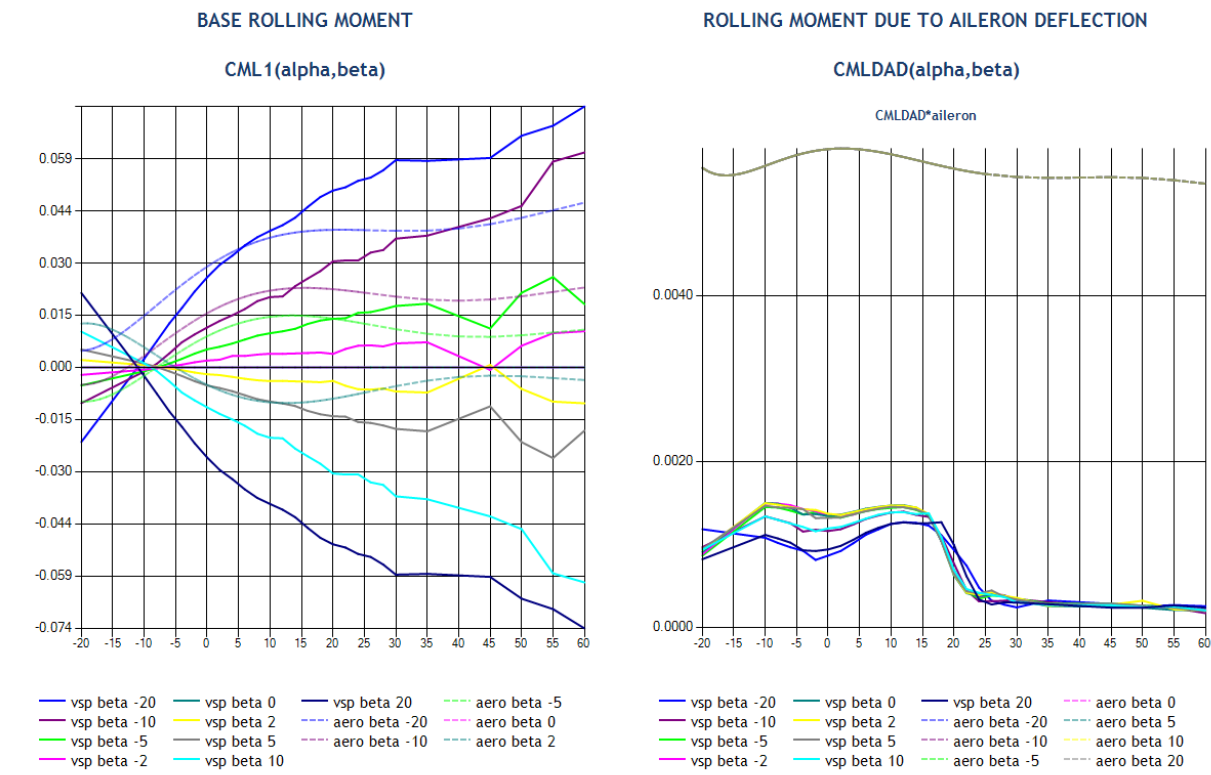
Axis	Buildup
DRAG	CFXB + CFXFLAPS
ROLL	CML1 + CMLDAD*aileron + CMLDRD*rudder + CMLDTD*DTALD + CMLP*PB + CMLR*RB

SIDE	CYDAD*aileron + CYDRD*rudder + CFYB + CFYDTD*DTALD + CFYP*PB + CFYR*RB
YAW	CMNDAD*aileron + CMNDRD*rudder + CMN1 + CMNDTD*DTALD + CMNR*RB + CMNP*PB
LIFT	CFZFLAPS + CFZB
PITCH	CMMFLAPS*flaps + CMM1 + CMMQ*QB

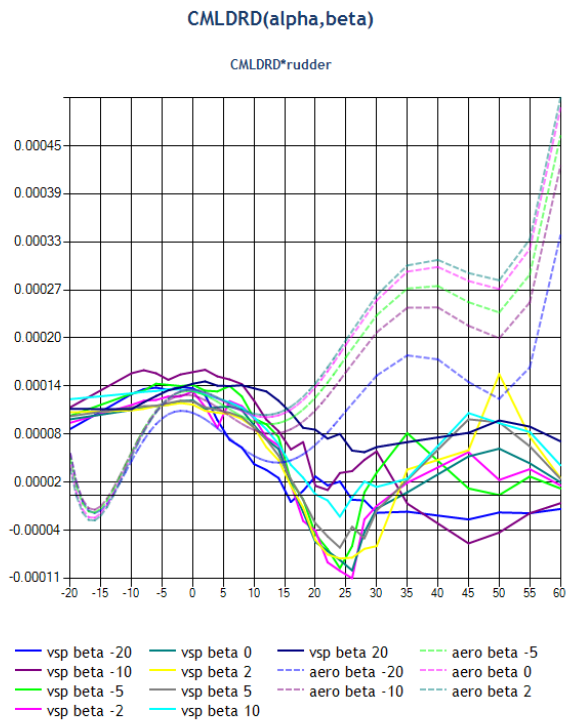
DRAG



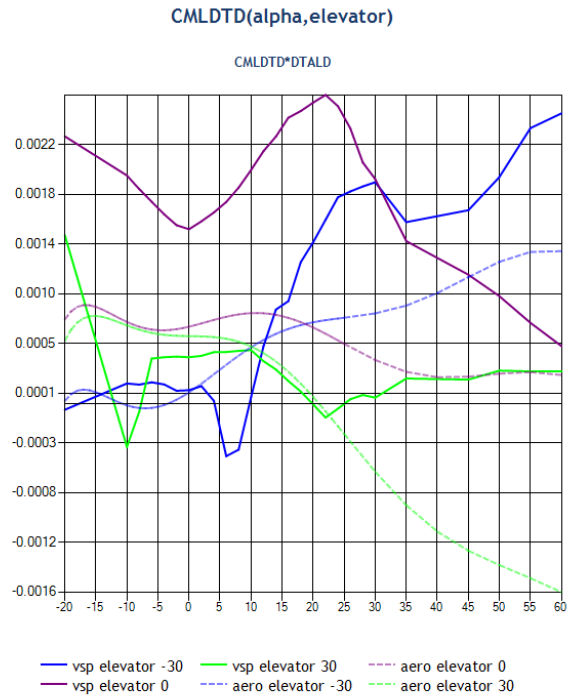
ROLL



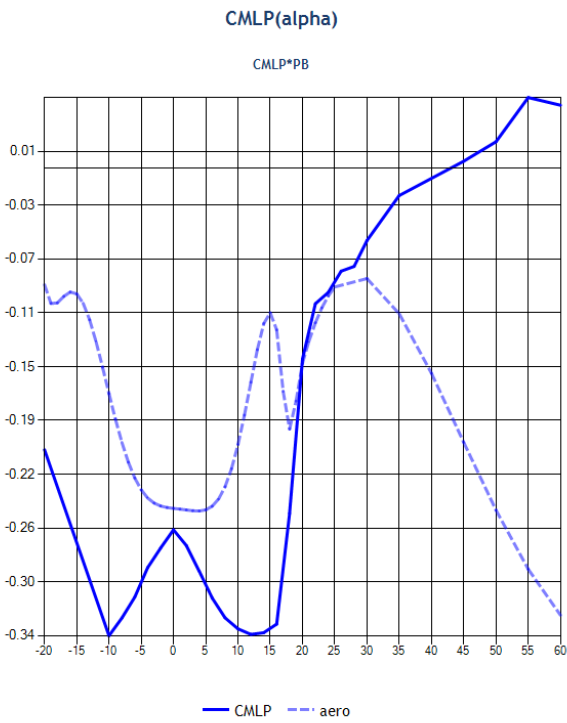
ROLLING MOMENT DUE TO RUDDER DEFLECTION



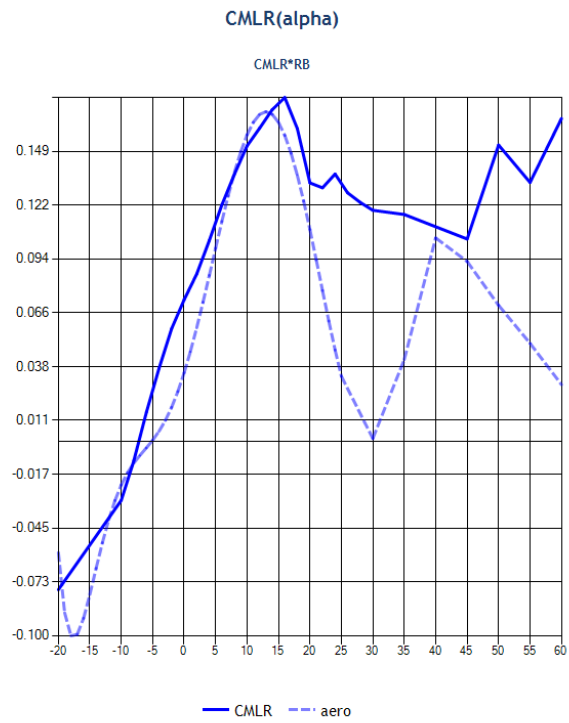
PITCH MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION - CLDD



ROLL DAMPING DERIVATIVE



ROLLING MOMENT DUE TO YAW RATE

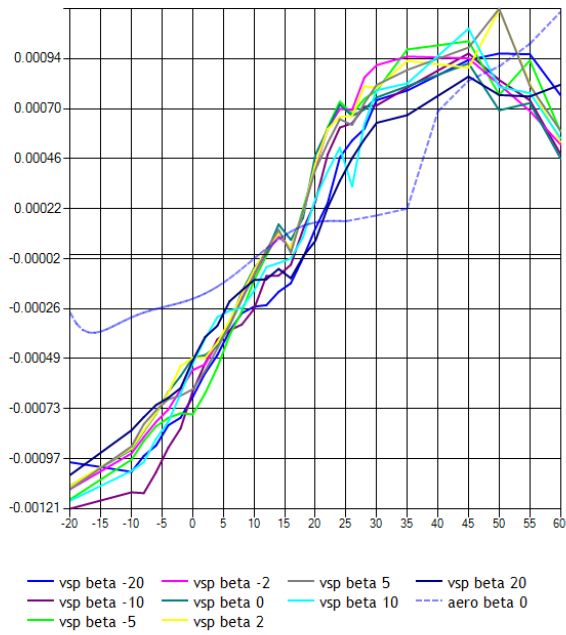


SIDE

SIDE FORCE DUE TO AILERON DEFLECTION

CYDAD(alpha,beta)

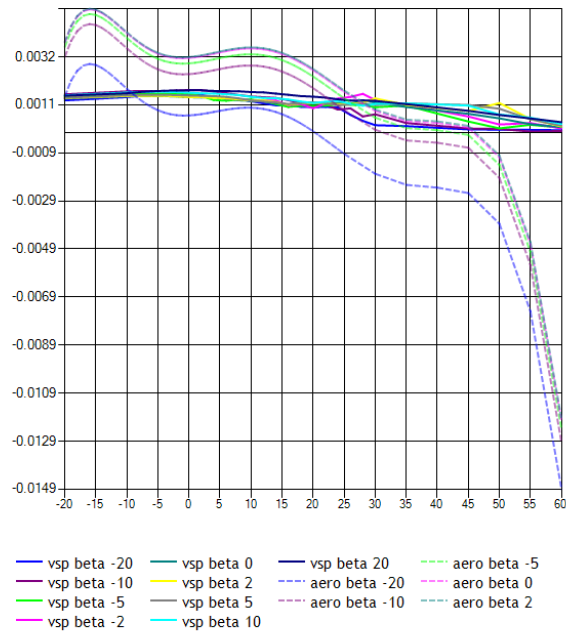
CYDAD*aileron



SIDE FORCE DUE TO RUDDER DEFLECTION

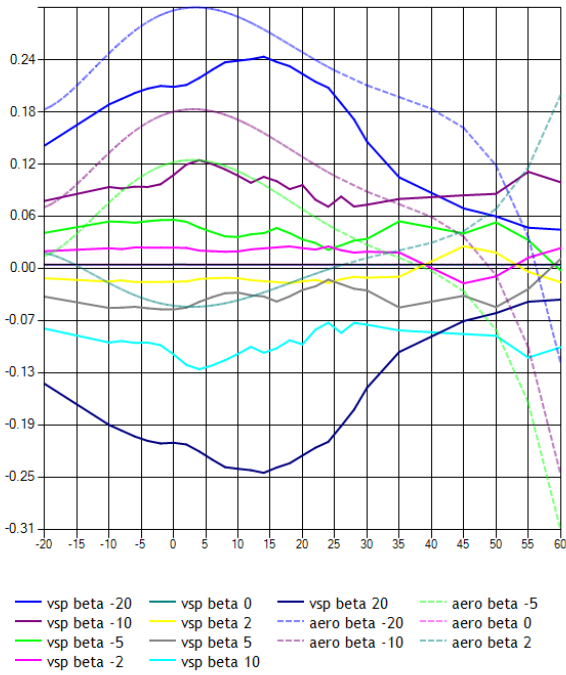
CYDRD(alpha,beta)

CYDRD*rudder



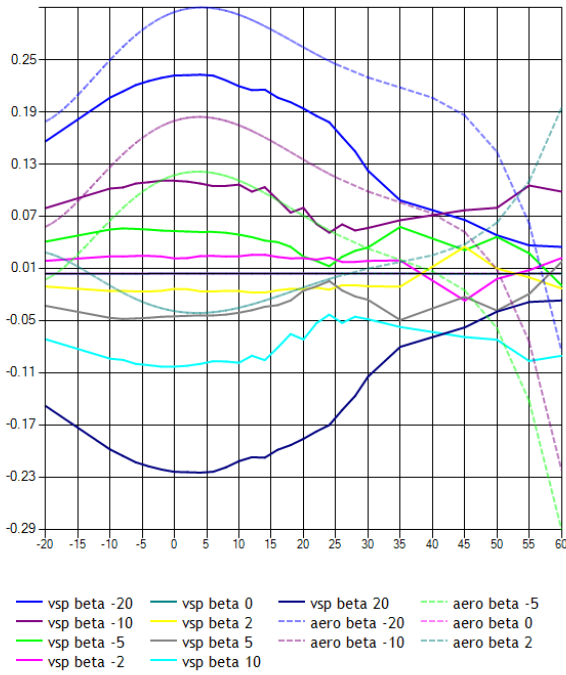
BASE SIDEFORCE

CFYB (alpha,beta,elevator=-30)



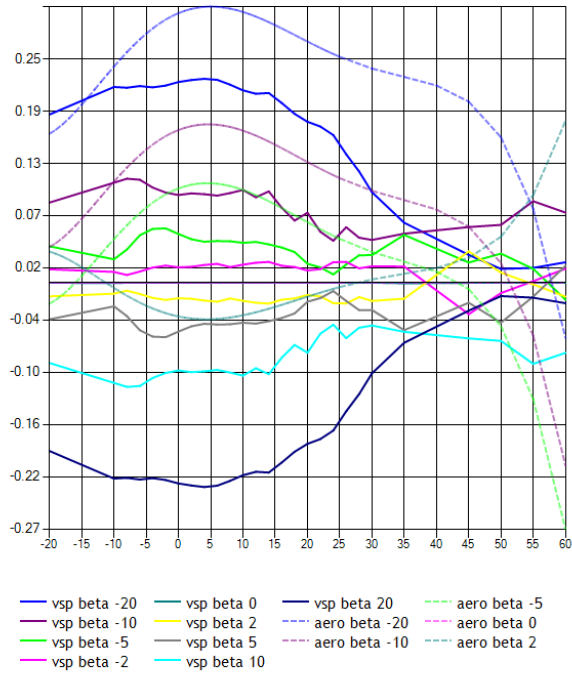
BASE SIDEFORCE

CFYB (alpha,beta,elevator=0)



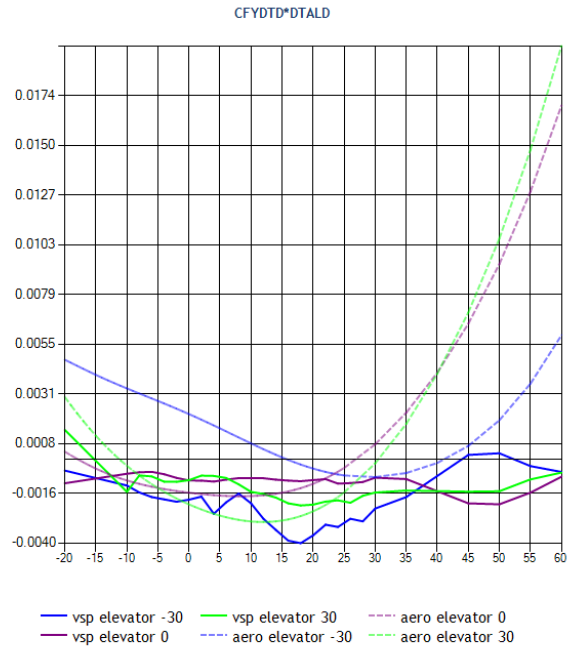
BASE SIDEFORCE

CFYB(alpha,beta,elevator=30)



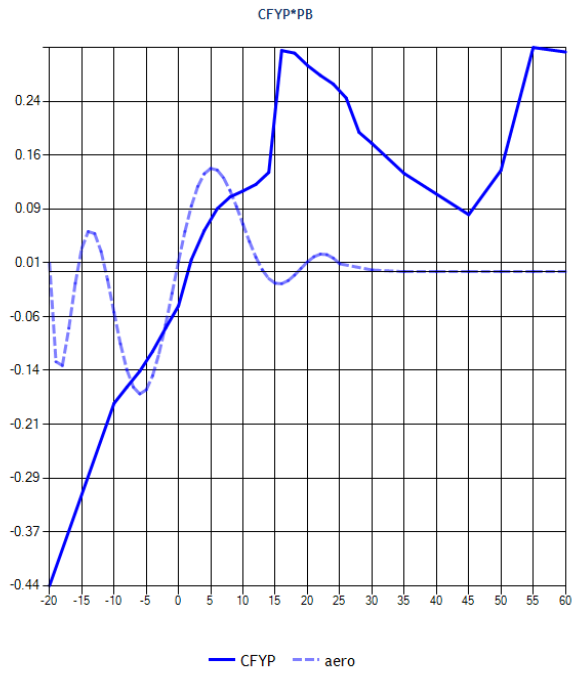
SIDE FORCE DUE TO DIFFERENTIAL TAIL DEFLECTION - CYDTD

CFYDTD(alpha,elevator)



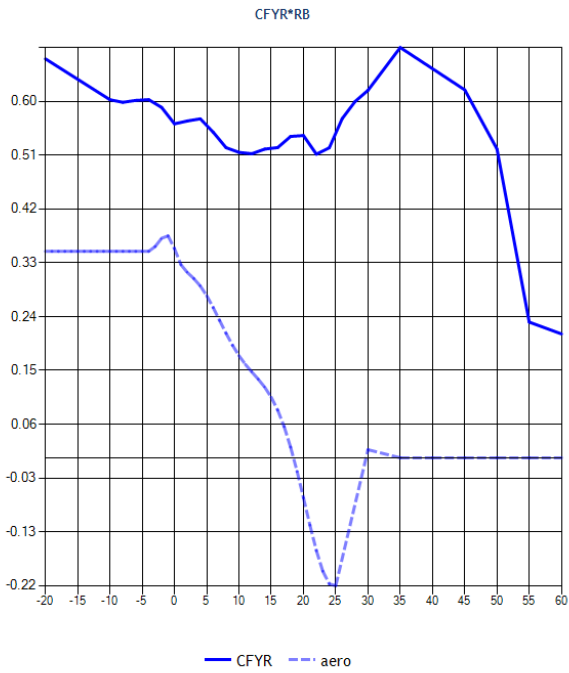
SIDE FORCE DUE TO ROLL RATE

CFYP(alpha)



SIDE FORCE DUE TO YAW RATE

CFYR(alpha)

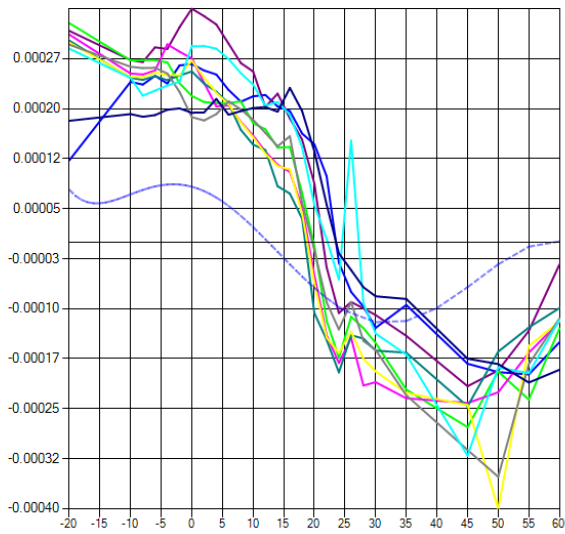


YAW

YAWING MOMENT DUE TO AILERON DEFLECTION

CMNDAD(alpha,beta)

CMNDAD*aileron

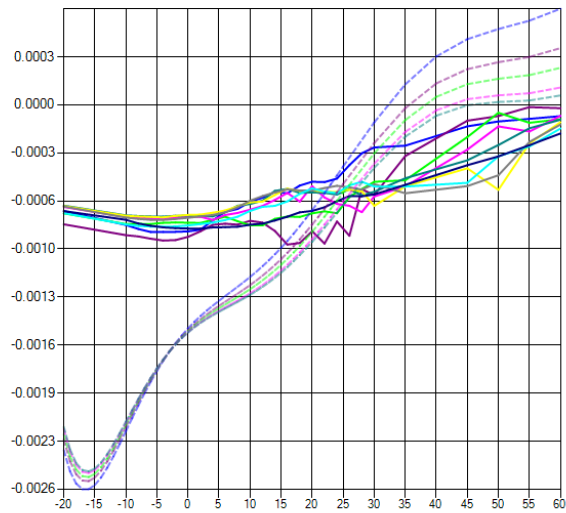


vsp beta -20 vsp beta -10 vsp beta -5 vsp beta -2 vsp beta 0 vsp beta 2 vsp beta 5 vsp beta 10 vsp beta 20 aero beta -20 aero beta -10 aero beta -5 aero beta 0 aero beta 2

YAWING MOMENT DUE TO RUDDER DEFLECTION

CMNDRD(alpha,beta)

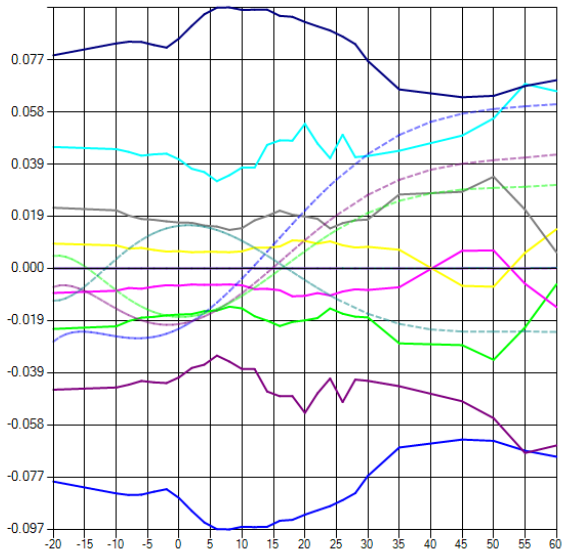
CMNDRD*rudder



vsp beta -20 vsp beta -10 vsp beta -5 vsp beta -2 vsp beta 0 vsp beta 2 vsp beta 5 vsp beta 10 vsp beta 20 aero beta -20 aero beta -10 aero beta -5 aero beta 0 aero beta 2

BASE YAWING MOMENT

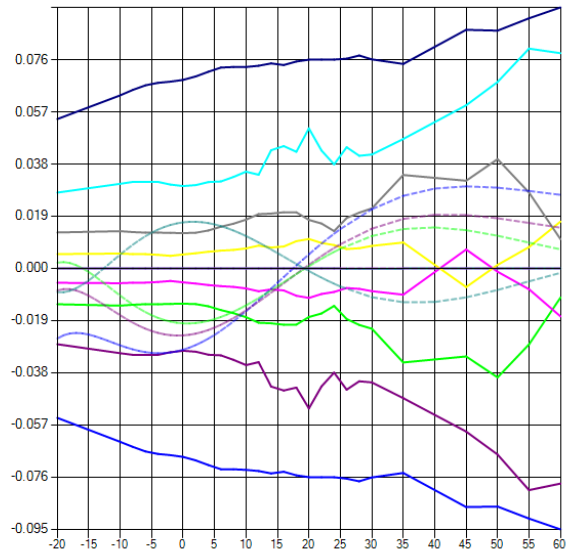
CMN1 (alpha,beta,elevator=-30)



vsp beta -20 vsp beta -10 vsp beta -5 vsp beta -2 vsp beta 0 vsp beta 2 vsp beta 5 vsp beta 10 vsp beta 20 aero beta -20 aero beta -10 aero beta -5 aero beta 0 aero beta 2

BASE YAWING MOMENT

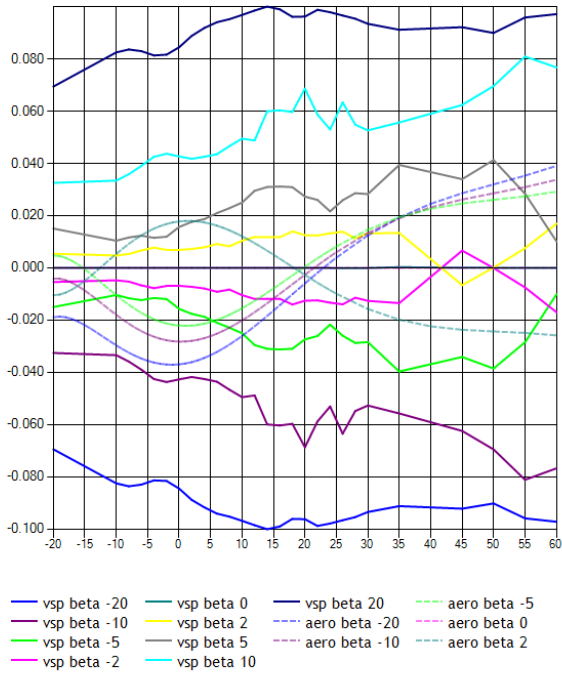
CMN1 (alpha,beta,elevator=0)



vsp beta -20 vsp beta -10 vsp beta -5 vsp beta -2 vsp beta 0 vsp beta 2 vsp beta 5 vsp beta 10 vsp beta 20 aero beta -20 aero beta -10 aero beta -5 aero beta 0 aero beta 2

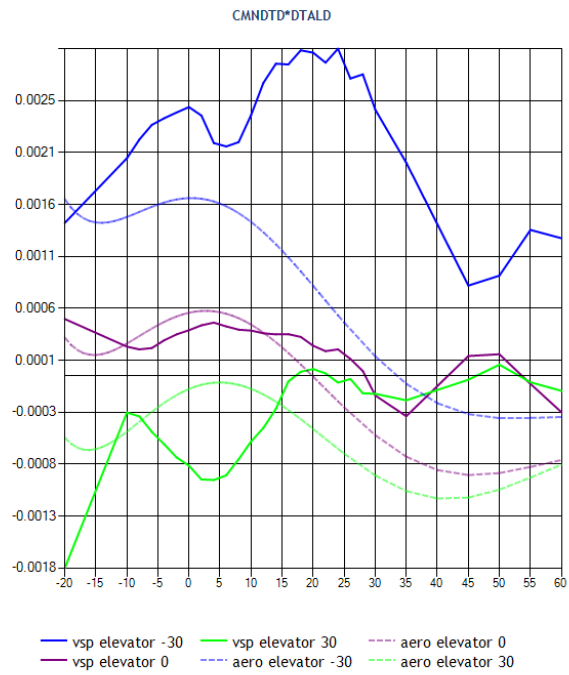
BASE YAWING MOMENT

CMN1 (alpha,beta,elevator=30)



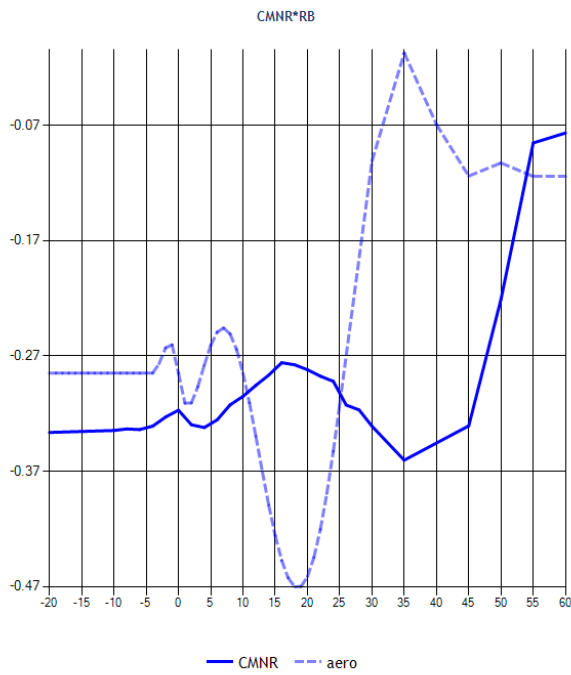
YAWING MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION

CMNDTD(alpha,elevator)



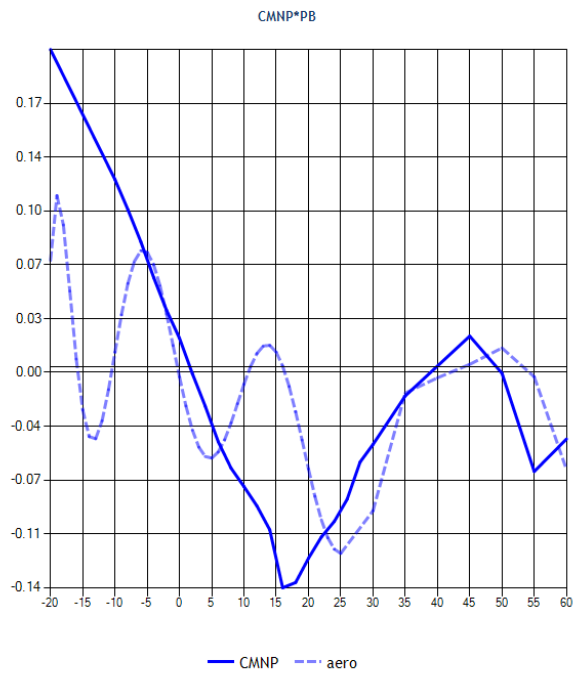
YAW DAMPING DERIVATIVE

CMNR(alpha)



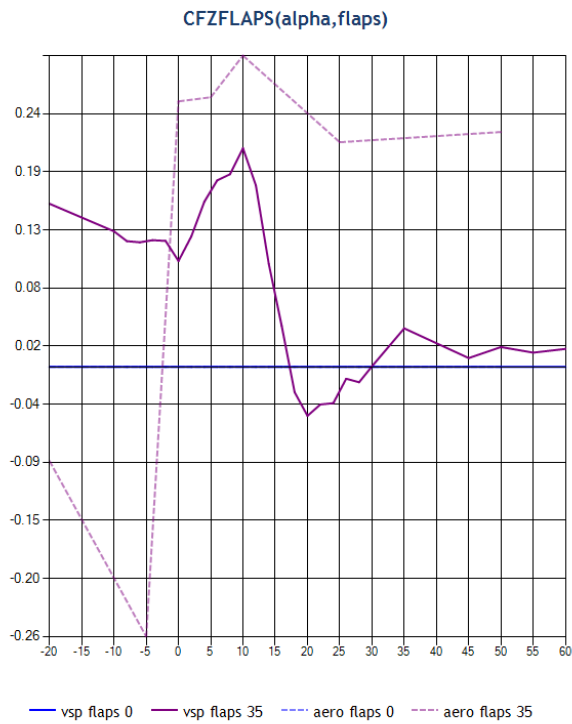
YAW MOMENT DUE TO ROLL RATE

CMNP(alpha)

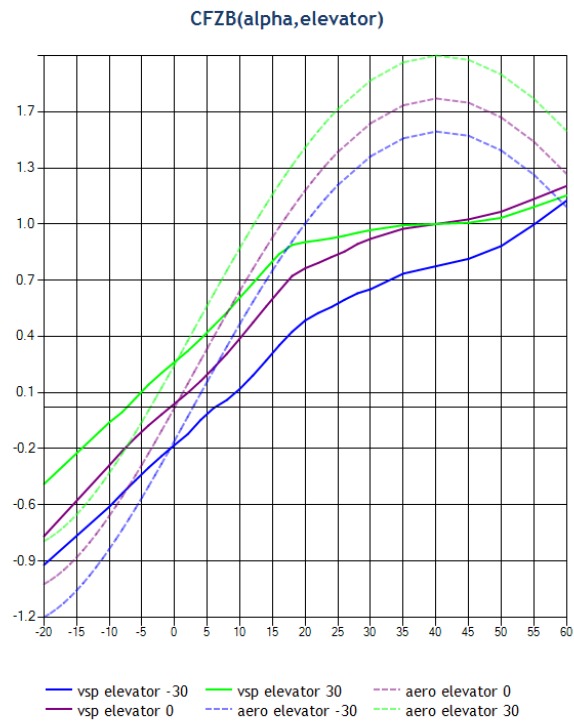


LIFT

LIFT INCREMENT DUE TO FLAPS

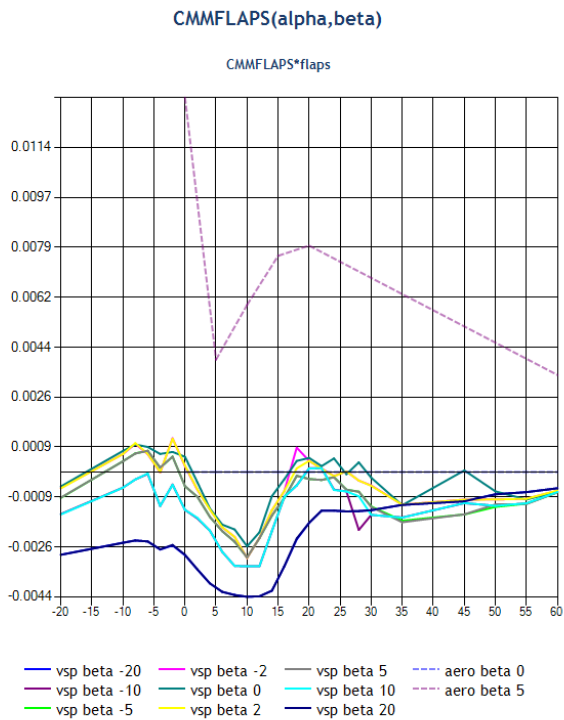


BASE LIFT

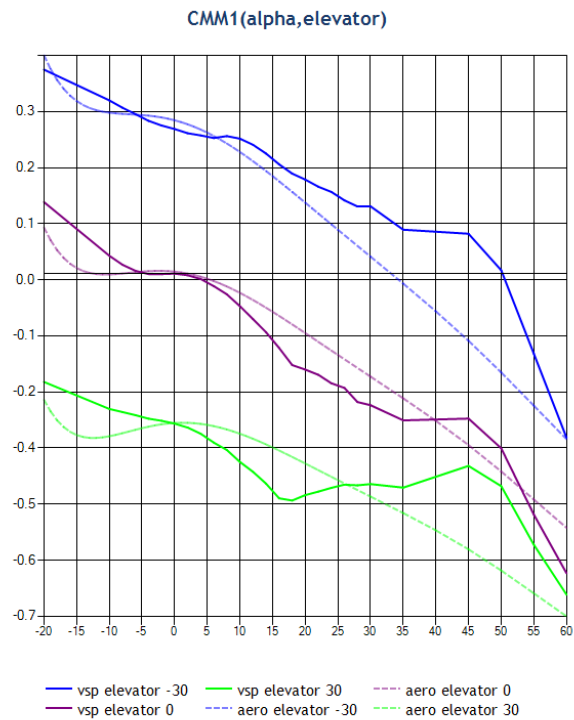


PITCH

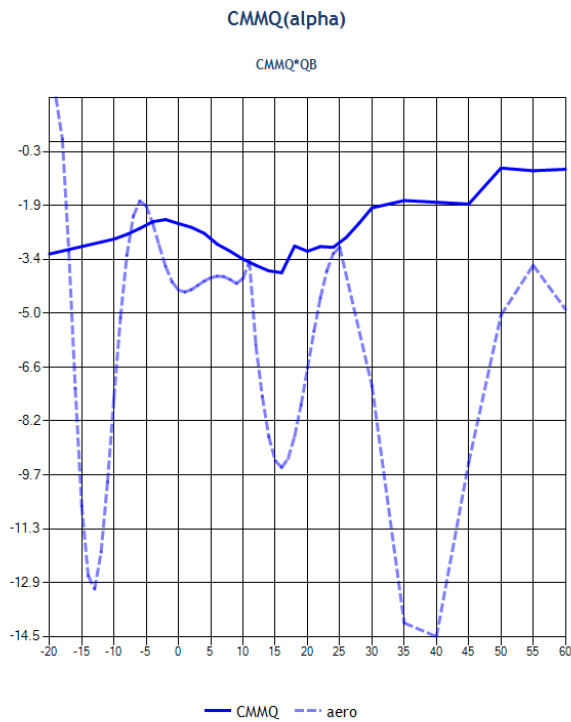
PITCHING MOMENT INCREMENT DUE TO FLAPS



BASE PITCHING MOMENT



PITCH DAMPING DERIVATIVE



References

- Richard Harrison, rjh@zaretto.com: F 15 Aerodynamic data built from vspero; CG (10, 0, 0.26)M, ZDAT/AED/2016/01-29, January, 2016: <http://www.zaretto.com/sites/zaretto.com/files/F-15-data/rjh-zaretto-F-15-aerodynamic-data-vspero.pdf>
- Richard Harrison, rjh@zaretto.com: F-15 Aerodynamic data from (AFIT/GAE/ENY/90D-16); CG 25.65%, ZDAT/AED/2014/12-2, December, 2014: <http://www.zaretto.com/sites/zaretto.com/files/F-15-data/rjh-zaretto-f-15-aerodynamic-data.pdf>
- Robert J. McDonnell, B.S., Captain, USAF: INVESTIGATION OF THE HIGH ANGLE OF ATTACK DYNAMICS OF THE F-15B USING BIFURCATION ANALYSIS, AFIT/GAE/ENY/90D-16, December 1990: <http://www.zaretto.com/sites/zaretto.com/files/F-15-data/ADA230462.pdf>
- Richard L. Bennet, Major, USAF: ANALYSIS OF THE EFFECTS OF REMOVING NOSE BALLAST FROM THE F-15 EAGLE, AFIT/GA/ENY/91D-1, December 1991: <http://www.zaretto.com/sites/zaretto.com/files/F-15-data/ADA244044.pdf>
- DR. J. R. LUMMUS, G. T. JOYCE, O C. D. O MALLEY: ANALYSIS OF WIND TUNNEL TEST RESULTS FOR A 9.39-PER CENT SCALE MODEL OF A VSTOL FIGHTER/ATTACK AIRCRAFT : VOLUME I - STUDY OVERVIEW, NASA CR-152391-VOL-1 Figure 3-2 p54, October 1980: <http://www.zaretto.com/sites/zaretto.com/files/F-15-data/19810014497.pdf>
- Frank W. Burcham, Jr., Trindel A. Maine, C. Gordon Fullerton, and Lannie Dean Webb: Development and Flight Evaluation of an Emergency Digital Flight Control System Using Only Engine Thrust on an F-15 Airplane, NASA TP-3627, September 1996: http://www.zaretto.com/sites/zaretto.com/files/F-15-data/88414main_H-2048.pdf
- Thomas R. Sisk and Neil W. Matheny: Precision Controllability of the F-15 Airplane, NASA-TM-72861, May 1979: http://www.zaretto.com/sites/zaretto.com/files/F-15-data/88414main_H-2048.pdf
- Sabc: Fuel Dumping System, 95-fuel-dumping-system, 08 September 2010: <http://www.f-15e.info/joomla/technology/fuel-system/95-fuel-dumping-system>
- Brandon Litherland: Using VSPAERO, VSPAERO, 2015/07/01 06:56: <http://www.openvsp.org/wiki/doku.php?id=vspaerotutorial>

Aircraft Metrics

Element	X	Y	Z	Unit
Aerodynamic Reference Point (CoP)	10.23	0.00	0.26	M
Aircraft CG	10.00	0.00	0.26	M

Element	Unit
Wingspan	M
Wing Area	M2
Wing Incidence	
CLMax	ND

Mass and balance

Element		Unit
Empty Weight	28000.00	LBS
IXX	28700.00	SLUG*FT2
IYY	165100.00	SLUG*FT2
IZZ	187900.00	SLUG*FT2
IXZ	-520.00	SLUG*FT2

Element	X	Y	Z	Unit	Weight
Station2-1	1.78	-3.83	0.29	M	0 LBS
Station2-2	1.41	-3.30	1.41	M	0 LBS
Station2-3	1.78	-3.83	0.29	M	0 LBS
Station3	-0.30	-1.61	0.57	M	0 LBS
Station4	3.59	-1.61	0.57	M	0 LBS
Station5	0.00	0.00	0.33	M	0 LBS
Station6	-0.30	1.61	0.57	M	0 LBS
Station7	3.59	1.61	0.57	M	0 LBS
Station8	1.78	3.83	0.29	M	0 LBS
Station9	1.41	3.30	1.41	M	0 LBS
Station10	1.78	3.83	0.29	M	0 LBS

Ground Reactions

Element	X	Y	Z	Unit	Index
NOSE_LG	197.00	0.00	-77.65	IN	0
LEFT_MLG	451.00	-98.00	-84.34	IN	1
RIGHT_MLG	451.00	98.00	-84.34	IN	2
LEFT_WING_TIP	472.00	-256.80	13.00	IN	3
RIGHT_WING_TIP	472.00	256.80	13.00	IN	4
CANOPY	214.00	0.00	10.00	IN	5
RADOME_FRONT	20.00	0.00	-18.00	IN	6
LEFT_VERTICAL_TAIL	744.00	-98.00	60.00	IN	7
RIGHT_VERTICAL_TAIL	744.00	98.00	60.00	IN	8
REAR_BODY_LEFT	669.00	-58.00	-12.00	IN	9
REAR_BODY_RIGHT	669.00	58.00	-12.00	IN	10
NOSE_CONE	0.00	0.00	-15.00	IN	11

Propulsion

Element	X	Y	Z	Unit	Feed
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F100-PW-100	682.00	-12.00	10.00	IN	RightFeedline [0],LeftFeedline [1],ExternalTank [2],RightExternalWingTank [3],LeftExternalWingTank [4],RightWingTank [5],LeftWingTank [6],RightConformalTank [7],LeftConformalTank [8],Tank1 [9],RightEngineFeed [10],LeftEngineFeed [11]
F100-PW-100	682.00	12.00	10.00	IN	RightFeedline [0],LeftFeedline [1],ExternalTank [2],RightExternalWingTank [3],LeftExternalWingTank [4],RightWingTank [5],LeftWingTank [6],RightConformalTank [7],LeftConformalTank [8],Tank1 [9],RightEngineFeed [10],LeftEngineFeed [11]

Tanks

Element	X	Y	Z	Unit	Capacity	Id	Priority	Standpipe
RightFeedline	489.00	38.00	-47.00	IN	10 LBS	0	1	
LeftFeedline	489.00	-38.00	-47.00	IN	10 LBS	1	1	
ExternalTank	386.00	0.00	-7.83	IN	3950 LBS	2	2	100 LBS
RightExternalWingTank	420.00	108.00	-7.83	IN	3950 LBS	3	3	100 LBS
LeftExternalWingTank	420.00	-108.00	-7.83	IN	3950 LBS	4	3	100 LBS
RightWingTank	457.02	130.32	15.35	IN	2750 LBS	5	4	100 LBS
LeftWingTank	457.02	-130.32	15.35	IN	2750 LBS	6	4	100 LBS
RightConformalTank	420.00	33.00	0.00	IN	4590 LBS	7	5	100 LBS
LeftConformalTank	420.00	-33.00	0.00	IN	4590 LBS	8	5	100 LBS
Tank1	307.42	7.48	14.57	IN	3300 LBS	9	6	100 LBS
RightEngineFeed	396.79	7.95	-5.51	IN	1500 LBS	10	6	
LeftEngineFeed	453.87	7.83	0.79	IN	1200 LBS	11	6	

Systems

Name
f-15-hydraulic
f-15-electrics
catapult
autoflight
f-15-cadc
f-15-cas
f-15-ecs
f-15-engines
hook
flight-controls

Independent variables

Name
aero/alpha-deg
aero/beta-deg
aero/pb
aero/qb

aero/rb

fcs/aileron-aero-deg

fcs/elevon-aero-deg

fcs/elevon-diff-aero-deg

fcs/flap-pos-deg

fcs/rudder-aero-deg