

F-15 Aerodynamic data built from vspaero; CG (10.233, 0, 0.222)M, 2018-10-29 14:13

Richard Harrison, rjh@zaretto.com, ZDAT/AED/2014/12-2
AeroDetail=Full, WakeIterations=1

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,elevator	DRAG	BASIC DRAG
CFZB	alpha,elevator	LIFT	BASIC LIFT
CMM1	alpha,elevator	PITCH	BASIC PITCHING MOMENT
CMMQ	alpha	PITCH	PITCH DAMPING DERIVATIVE
CML1	alpha,beta	ROLL	BASIC ROLLING MOMENT
CMLP	alpha	ROLL	ROLL DAMPING DERIVATIVE
CMLDAD	alpha	ROLL	ROLLING MOMENT DUE TO AILERON DEFLECTION
CMLDTD	alpha,elevator	ROLL	ROLLING MOMENT DUE TO DIFFERENTIAL TAIL 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	BASIC SIDE FORCE
CYDAD	alpha	SIDE	SIDE FORCE DUE TO AILERON DEFLECTION
CYDTD	alpha,elevator	SIDE	SIDE FORCE DUE TO DIFFERENTIAL TAIL DEFLECTION
CFYP	alpha	SIDE	SIDE FORCE DUE TO ROLL RATE
CYDRD	alpha	SIDE	SIDE FORCE DUE TO RUDDER DEFLECTION
CFYR	alpha	SIDE	SIDE FORCE DUE TO YAW RATE
CMN1	alpha,beta,elevator	YAW	BASIC YAWING MOMENT
CMNR	alpha	YAW	YAW DAMPING DERIVATIVE
CMNDAD	alpha	YAW	YAWING MOMENT DUE TO AILERON DEFLECTION
CMNDTD	alpha,elevator	YAW	YAWING MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION
CMNP	alpha	YAW	YAWING MOMENT DUE TO ROLL RATE
CMNDRDr	alpha,beta	YAW	YAWING MOMENT DUE TO RUDDER DEFLECTION

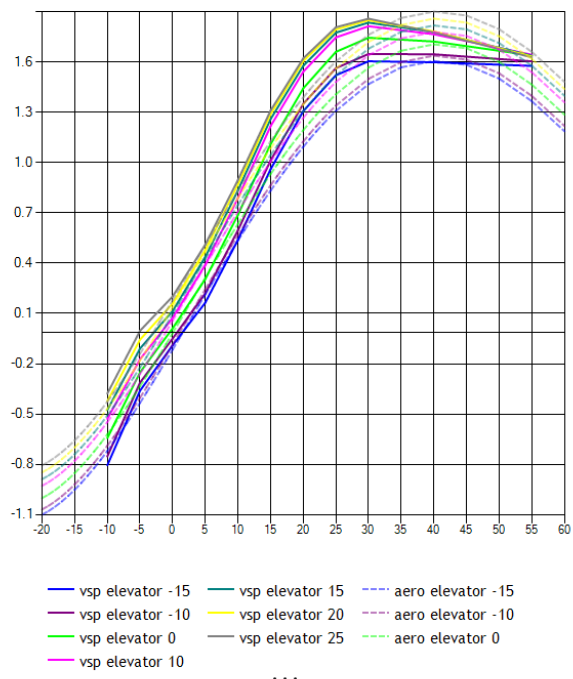
Coefficient Buildup

Axis	Buildup
LIFT	CFZB
DRAG	CFXB
SIDE	CFYB + CYDAD*DDA + CYDRD*DRUDD + CYDTD*DTFLX5*DTALD + CFYP*PB + CFYR*RB
ROLL	CML1 + CMLDAD*DDA + CMLDRD*DRUDD*DRFLX1*EPA43 + CMLDTD*DTFLX1*DTALD + CMLP*PB + CMLR*RB + (DLNB*BETA)
PITCH	CMM1 + CMMQ*QB
YAW	CMN1 + CMNDAD*DDA + CMNDRDr*DRUDD*EPA43 + CMNDTD*DTFLX3*DTALD + CMNP*PB + CMNR*RB + (DCNB*BETA)

LIFT

BASIC LIFT

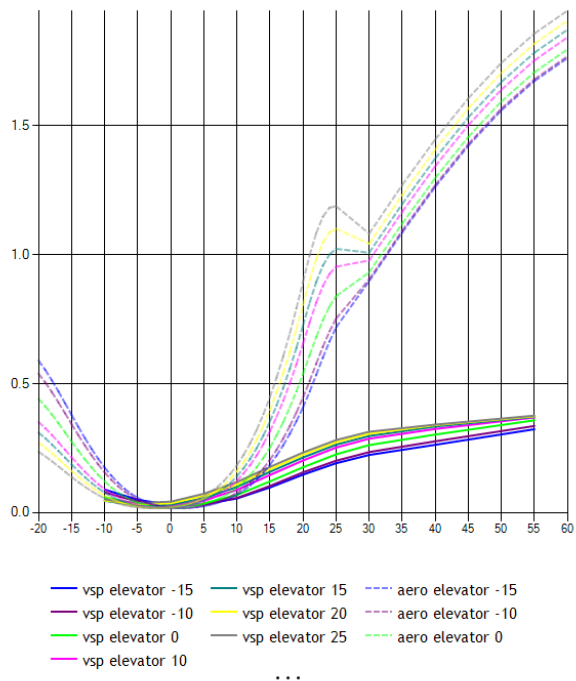
CFZB(alpha,elevator)



DRAG

BASIC DRAG

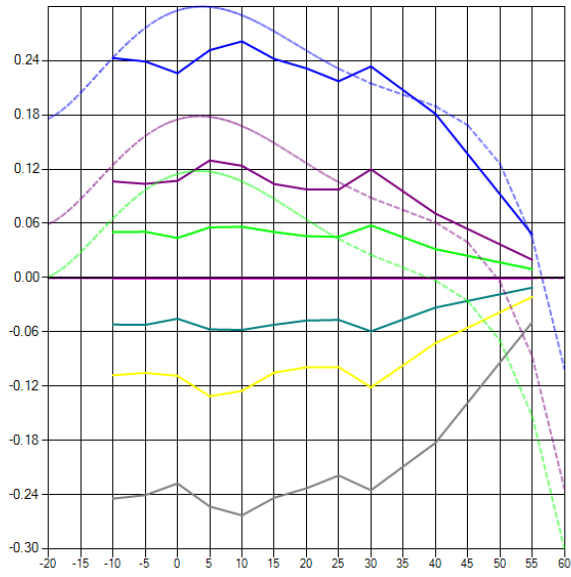
CFXB(alpha,elevator)



SIDE

BASIC SIDE FORCE

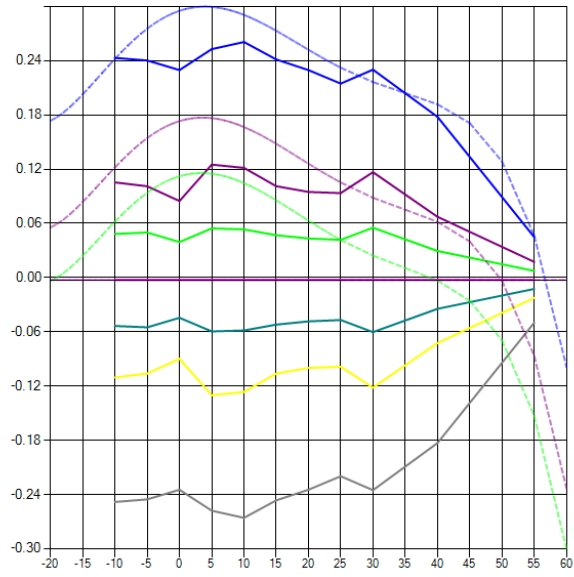
CFYB (alpha,beta,elevator=-15)



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

BASIC SIDE FORCE

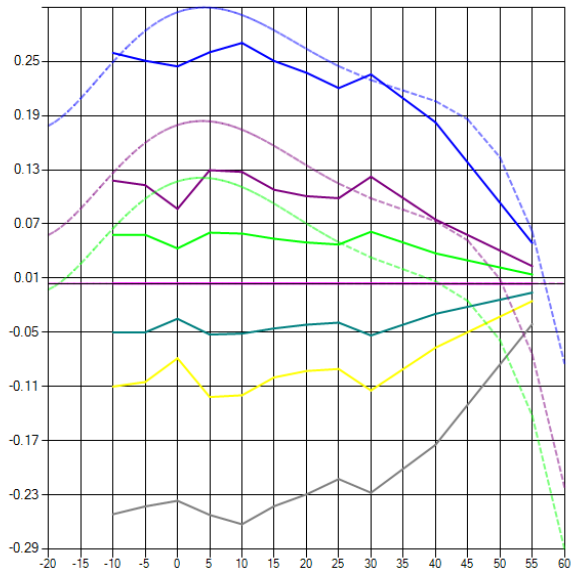
CFYB (alpha,beta,elevator=-10)



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vsp beta -10 vsp beta 0 vsp beta 10 aero beta -20
...

BASIC SIDE FORCE

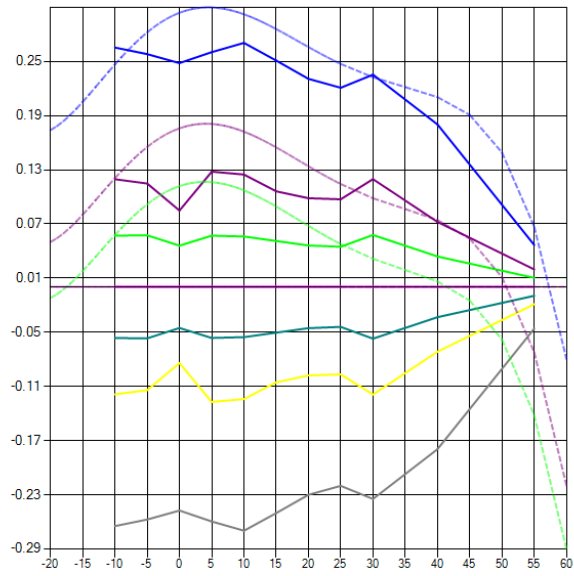
CFYB (alpha,beta,elevator=0)



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...

BASIC SIDE FORCE

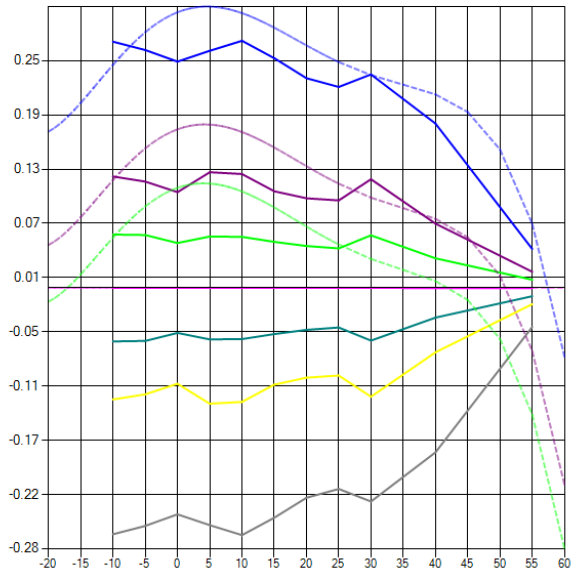
CFYB (alpha,beta,elevator=10)



vsp beta -20 vsp beta -5 vsp beta 5 vsp beta 20
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...

BASIC SIDE FORCE

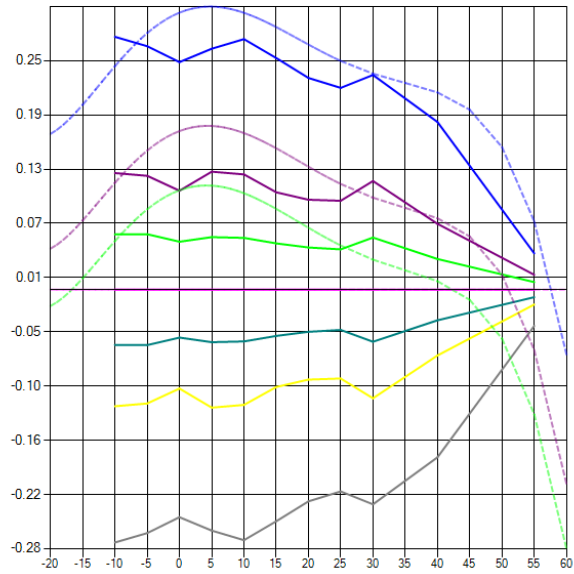
CFYB (alpha,beta,elevator=15)



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

BASIC SIDE FORCE

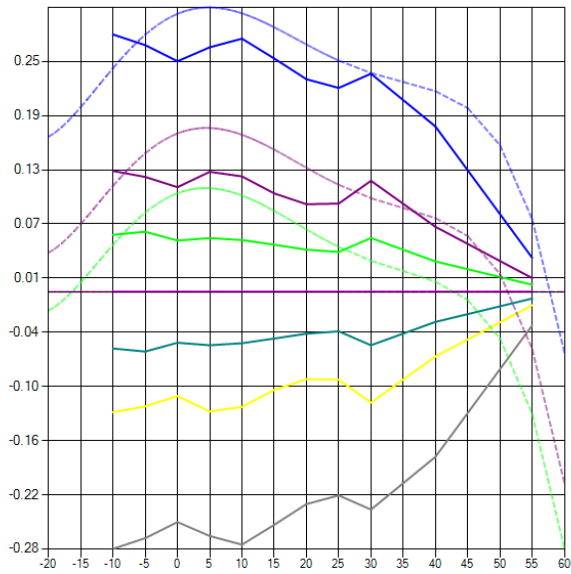
CFYB (alpha,beta,elevator=20)



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

BASIC SIDE FORCE

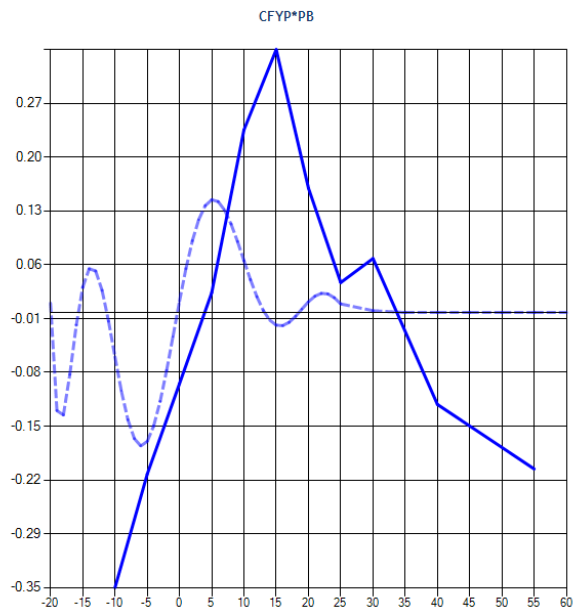
CFYB (alpha,beta,elevator=25)



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

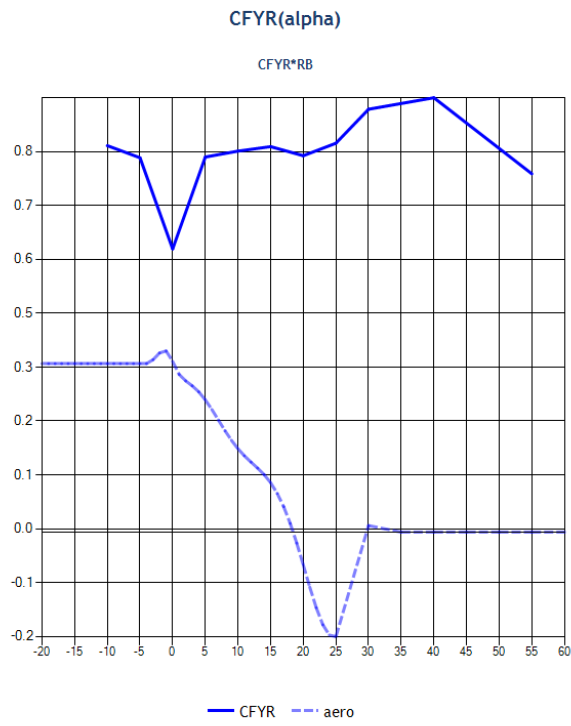
SIDE FORCE DUE TO ROLL RATE

CFYP(alpha)

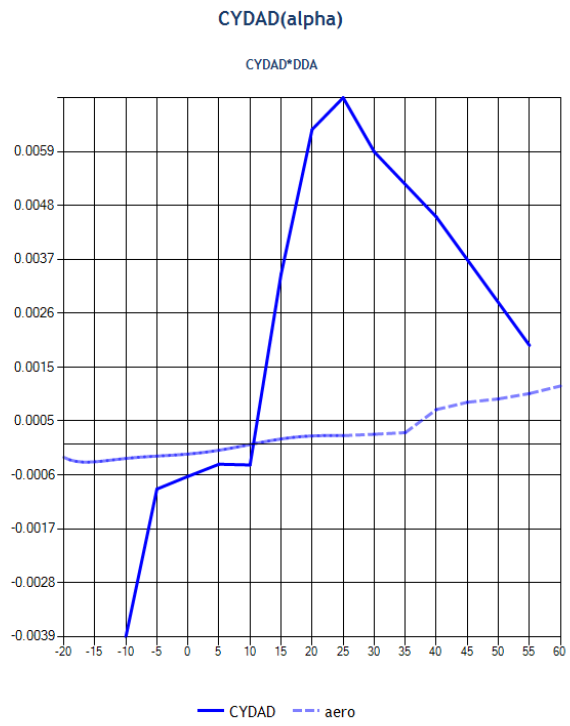


CFYP aero

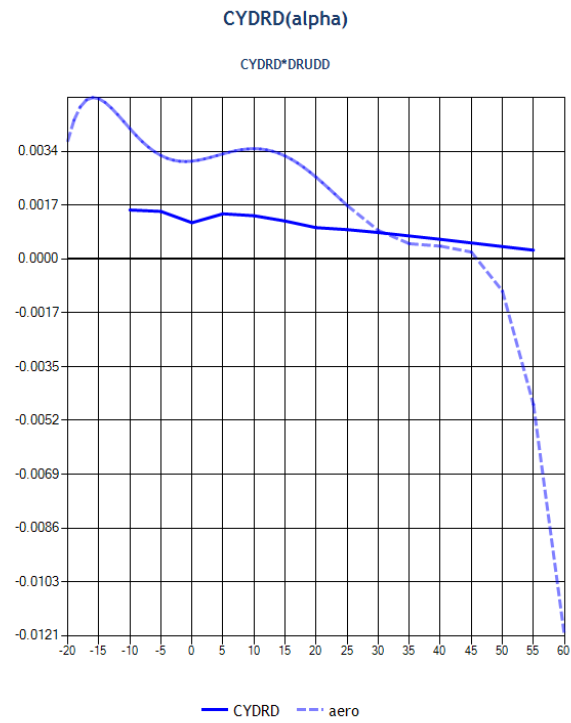
SIDE FORCE DUE TO YAW RATE



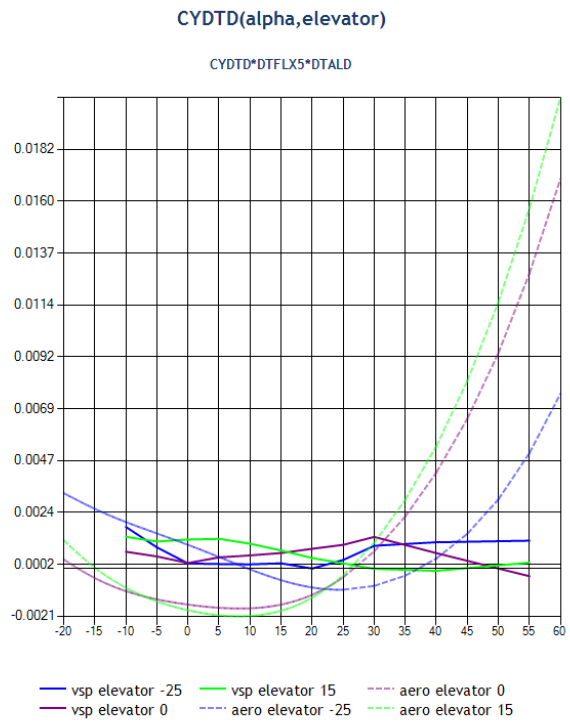
SIDE FORCE DUE TO AILERON DEFLECTION



SIDE FORCE DUE TO RUDDER DEFLECTION



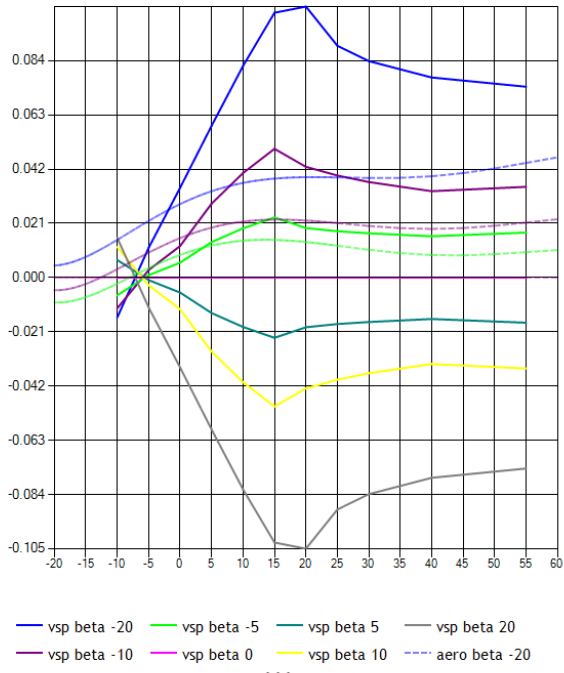
SIDE FORCE DUE TO DIFFERENTIAL TAIL DEFLECTION



ROLL

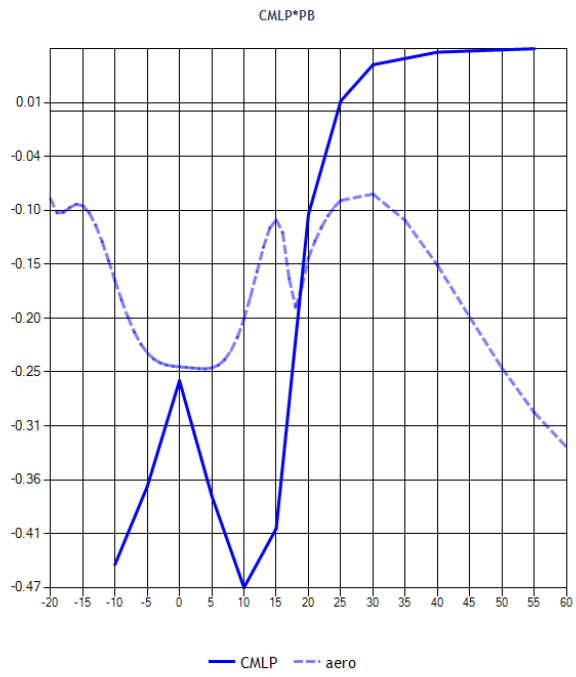
BASIC ROLLING MOMENT

CML1(alpha,beta)



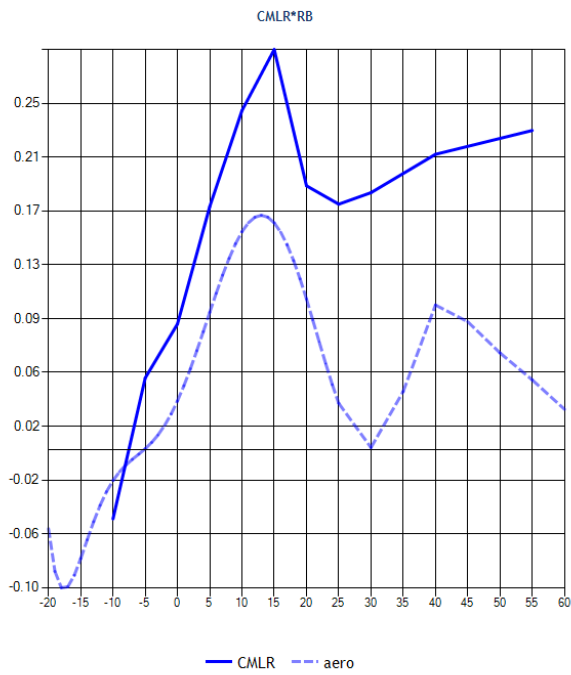
ROLL DAMPING DERIVATIVE

CMLP(alpha)



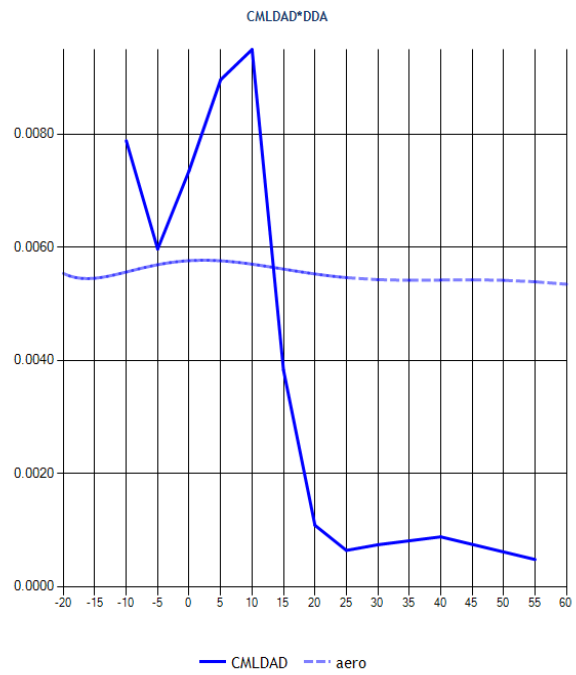
ROLLING MOMENT DUE TO YAW RATE

CMLR(alpha)



ROLLING MOMENT DUE TO AILERON DEFLECTION

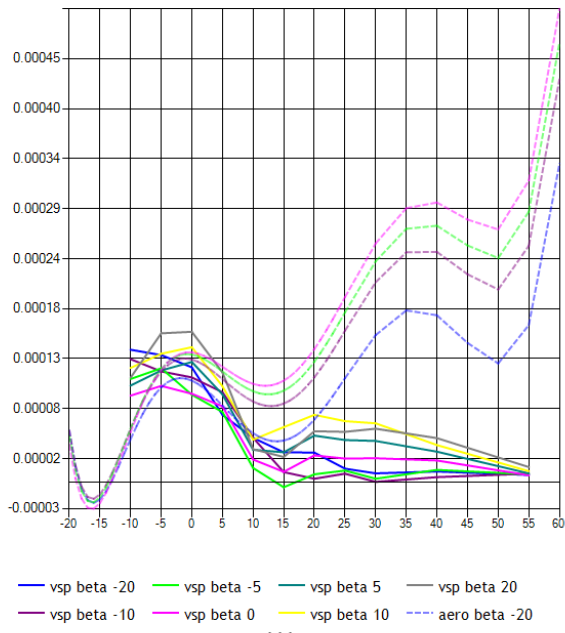
CMLDAD(alpha)



ROLLING MOMENT DUE TO RUDDER DEFLECTION

CMLDRD(alpha,beta)

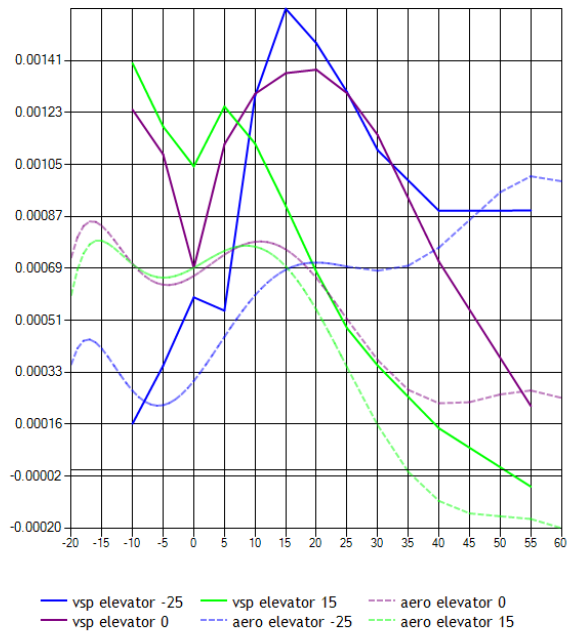
CMLDRD*DRUDD*DRFLX1*EPA43



ROLLING MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION

CMLDTD(alpha,elevator)

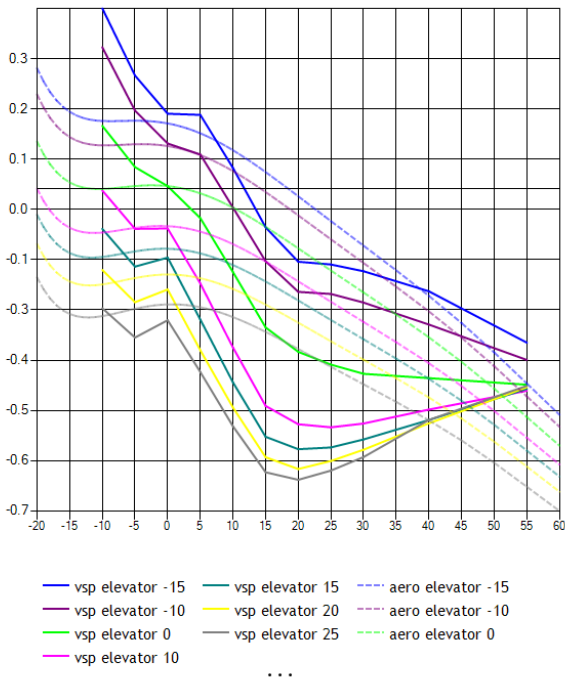
CMLDTD*DTFLX1*DTALD



PITCH

BASIC PITCHING MOMENT

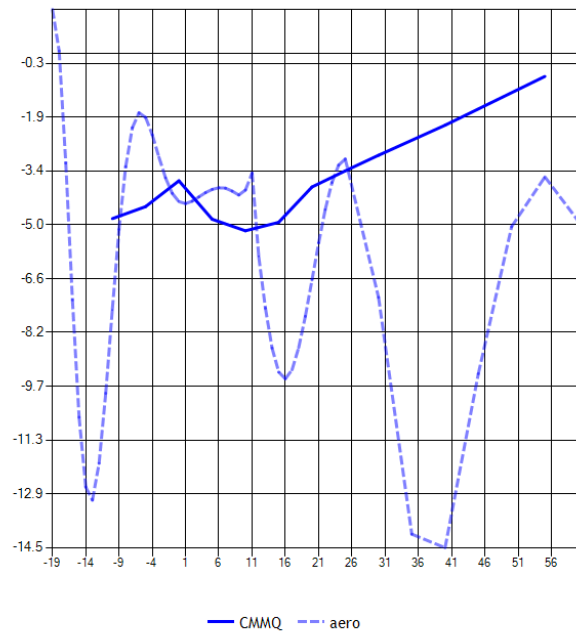
CMM1(alpha,elevator)



PITCH DAMPING DERIVATIVE

CMMQ(alpha)

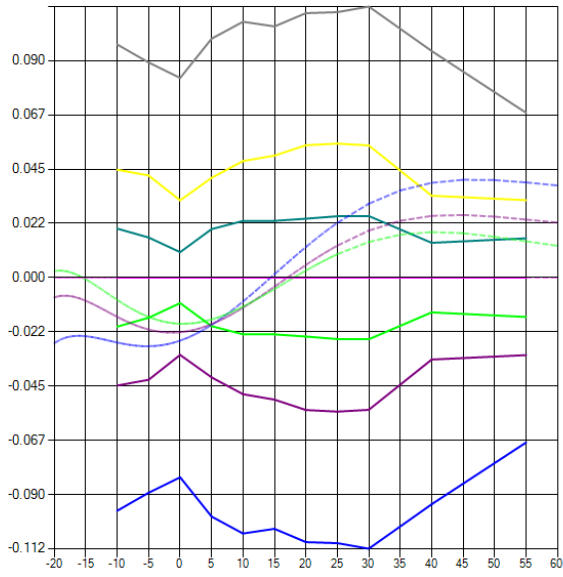
CMMQ*QB



YAW

BASIC YAWING MOMENT

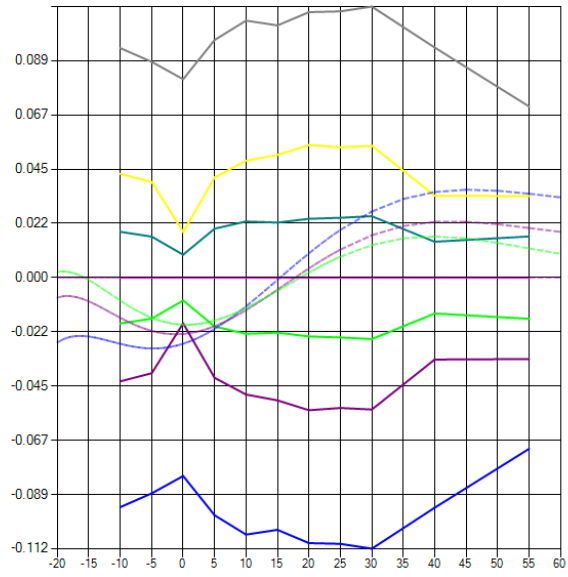
CMN1 (alpha,beta,elevator=-15)



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

BASIC YAWING MOMENT

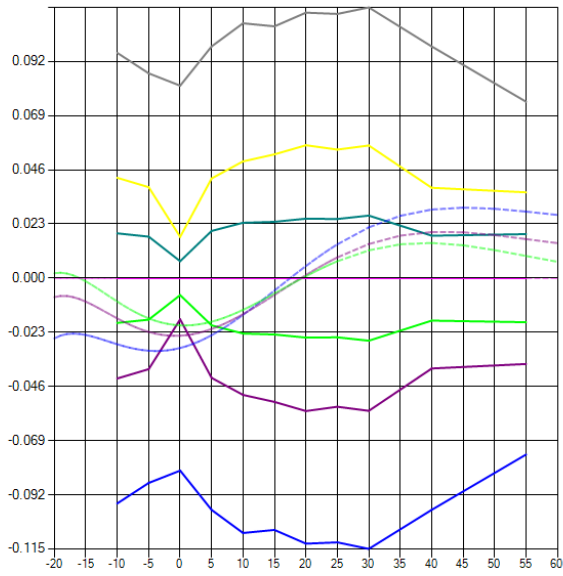
CMN1 (alpha,beta,elevator=-10)



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

BASIC YAWING MOMENT

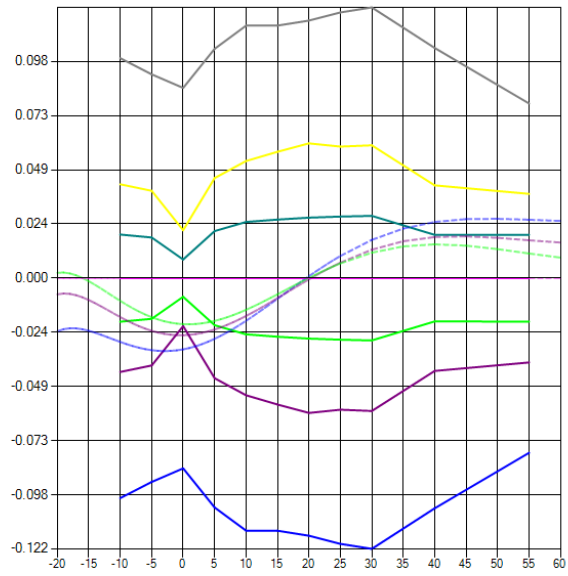
CMN1 (alpha,beta,elevator=0)



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vsp beta -10 vsp beta 0 vsp beta 10 aero beta -20
...

BASIC YAWING MOMENT

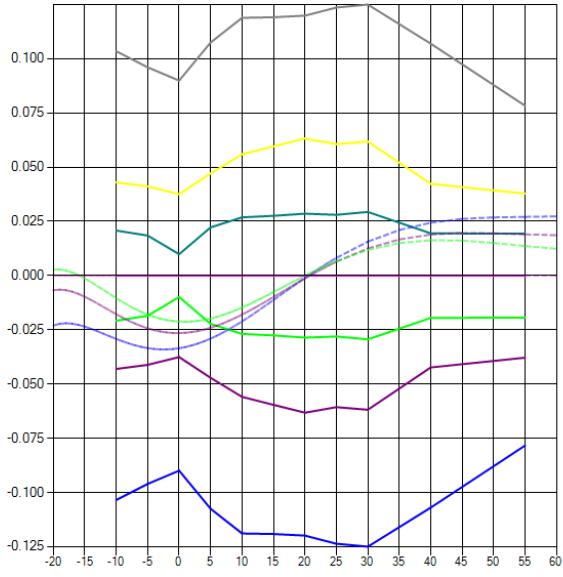
CMN1 (alpha,beta,elevator=10)



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

BASIC YAWING MOMENT

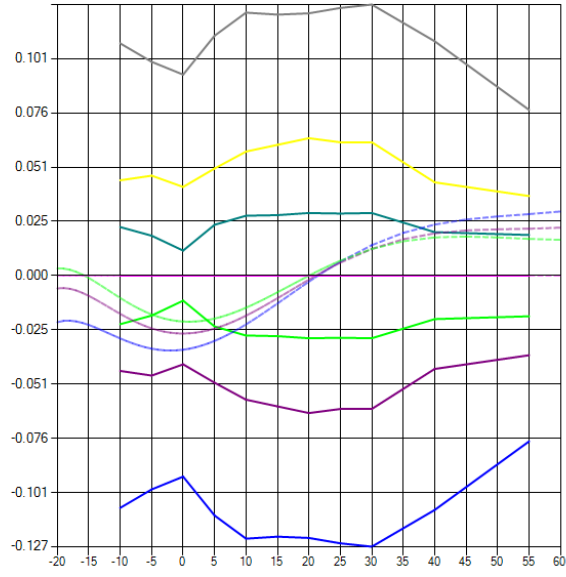
CMN1 (alpha,beta,elevator=15)



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

BASIC YAWING MOMENT

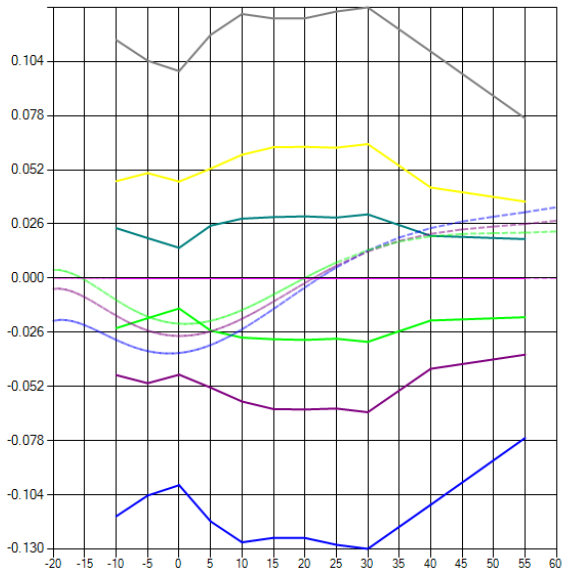
CMN1 (alpha,beta,elevator=20)



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

BASIC YAWING MOMENT

CMN1 (alpha,beta,elevator=25)

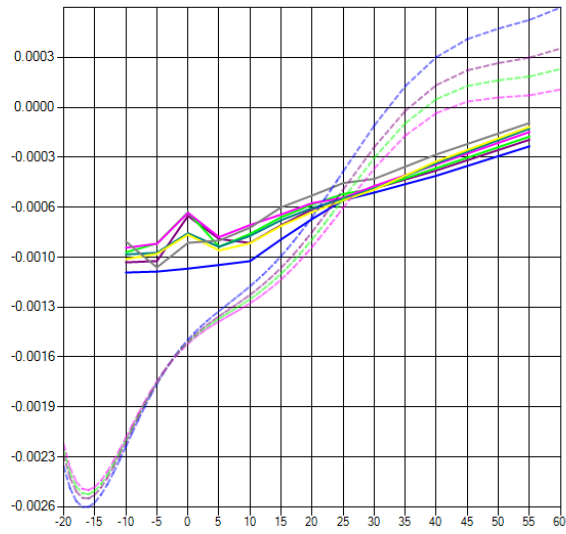


vsp beta -20 vsp beta -5 vsp beta 5 vsp beta 20
 vsp beta -10 vsp beta 0 vsp beta 10 aero beta -20

YAWING MOMENT DUE TO RUDDER DEFLECTION

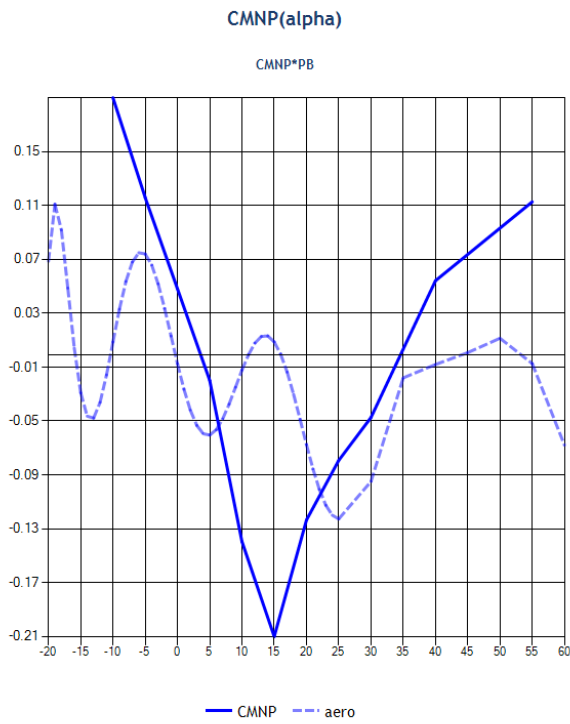
CMNDRDr(alpha,beta)

CMNDRDr*DRUDD*EPA43

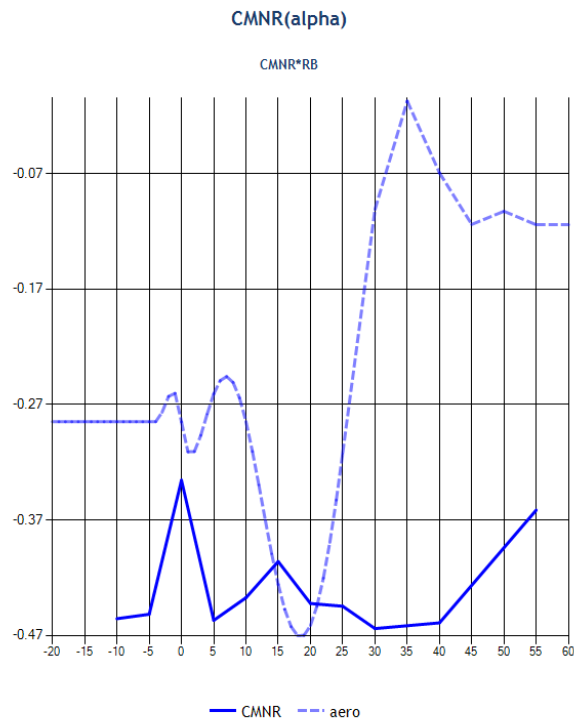


vsp beta -20 vsp beta -5 vsp beta 5 vsp beta 20
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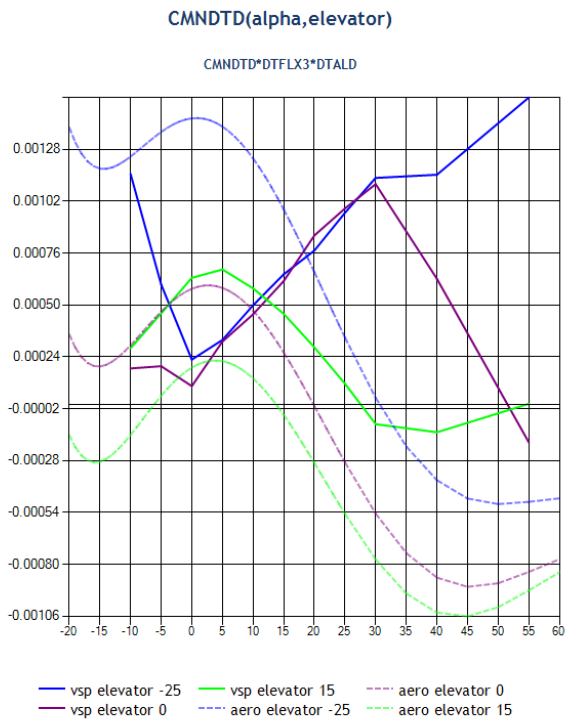
YAWING MOMENT DUE TO ROLL RATE



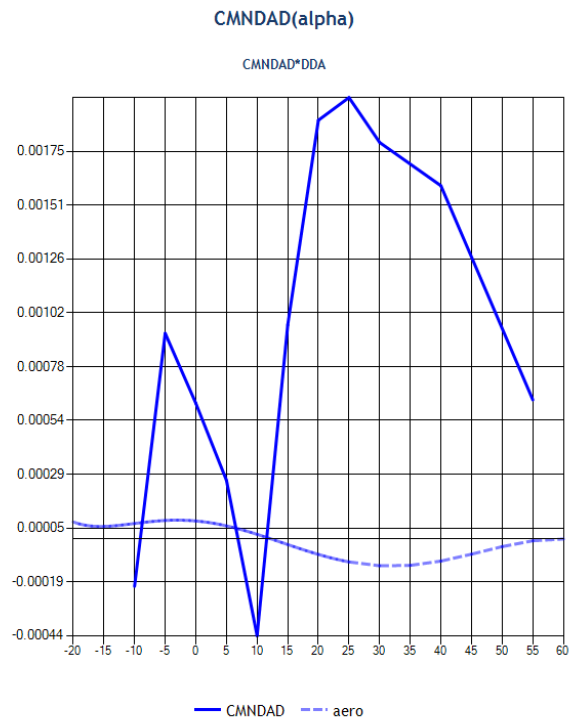
YAW DAMPING DERIVATIVE



YAWING MOMENT DUE TO DIFFERENTIAL TAIL DEFLECTION



YAWING MOMENT DUE TO AILERON DEFLECTION



References

1. Richard Harrison, rjh@zaretto.com: F-15 Aerodynamic data built from vsp aero; CG (10.233, 0, 0.222)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-vspaero.pdf>
2. 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>
3. 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>
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6. 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

7. 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

8. Sabc: Fuel Dumping System, 95-fuel-dumping-system, 08 September 2010: <http://www.f-15e.info/joomla/technology/fuel-system/95-fuel-dumping-system>

9. Brandon Litherland: Using VSPAERO, VSPAERO, 2015/07/01 06:56: <http://www.openvsp.org/wiki/doku.php?id=vspaerotutorial>

Mass and balance

Element	X	Y	Z	Unit
Aerodynamic Reference Point (CoP)	10.63	0.00	0.22	M
Aircraft CG	10.23	0.00	0.22	M

Element	Unit
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

Metrics

Element	Unit
Chord	4.86 M
Wingspan	13.05 M
Wing Area	56.49 M2
Wing Incidence	0.00 DEG
CIMax	1.73 ND

Propulsion

Element	X	Y	Z	Unit	Feed
F100-PW-100	682.00	-12.00	0.00	IN	Left Feed line [1],External Tank [2],Right External Wing Tank [3],Left External Wing Tank [4],Right Wing Tank [5],Left Wing Tank [6],Right Conformal Tank [7],Left Conformal Tank [8],Tank 1 [9],Right Engine Feed [10],Left Engine Feed [11]
F100-PW-100	682.00	12.00	0.00	IN	Right Feed line [0],External Tank [2],Right External Wing Tank [3],Left External Wing Tank [4],Right Wing Tank [5],Left Wing Tank [6],Right Conformal Tank [7],Left Conformal Tank [8],Tank 1 [9],Right Engine Feed [10],Left Engine Feed [11]

Tanks

Element	X	Y	Z	Unit	Capacity	Id	Priority	Standpipe
Right Feed line	489.00	38.00	-47.00	IN	10 LBS	0	1	
Left Feed line	489.00	-38.00	-47.00	IN	10 LBS	1	1	
External Tank	386.00	0.00	-7.83	IN	3950 LBS	2	2	100 LBS
Right External Wing Tank	420.00	108.00	-7.83	IN	3950 LBS	3	3	100 LBS
Left External Wing Tank	420.00	-108.00	-7.83	IN	3950 LBS	4	3	100 LBS
Right Wing Tank	457.02	130.32	15.35	IN	2750 LBS	5	4	100 LBS
Left Wing Tank	457.02	-130.32	15.35	IN	2750 LBS	6	4	100 LBS
Right Conformal Tank	420.00	33.00	0.00	IN	4590 LBS	7	5	100 LBS
Left Conformal Tank	420.00	-33.00	0.00	IN	4590 LBS	8	5	100 LBS
Tank 1	307.42	7.48	14.57	IN	3300 LBS	9	6	100 LBS
Right Engine Feed	396.79	7.95	-5.51	IN	1500 LBS	10	6	
Left Engine Feed	453.87	7.83	0.79	IN	1200 LBS	11	6	

Systems

Name
f-15-hydraulic
f-15-electrics

catapult

f-15-cadc

f-15-ecs

f-15-engines

hook

flight-controls

Independent variables

Name

0.85

0.975

0.975

0.975

1

aero/alpha-deg

aero/beta-deg

aero/pb

aero/qb

aero/rb

fcs/aileron-pos-deg

fcs/differential-elevator-pos-deg

fcs/elevator-pos-deg

fcs/rudder-pos-deg
