

# A320 200 Aerodynamic data built from vspaero; AeroDatum (16.1, 0, 0)M, 2018-05-12 12:27

Richard Harrison, rjh@zaretto.com, ZDAT/AED/2018/03-07

Copyright (C) 2016 Richard Harrison, All rights reserved

AeroDetail=Full, MultiSampleAero, MultiSampleDerivatives, WakeIterations=4

## Model summary

Dependent variable	Independent variables	Axis	Description
CFXB	alpha,beta	DRAG	BASE DRAG
CFXDFM	alpha,flaps	DRAG	DRAG INCREMENT DUE TO FLAPS
CFXGEAR	alpha	DRAG	DRAG INCREMENT DUE TO GEAR
CFXDADL	alpha,beta	DRAG	DRAG INCREMENT DUE TO LEFT AILERON DEFLECTION
CFXMN	mach,alpha	DRAG	DRAG INCREMENT DUE TO MACH
CFXDADR	alpha,beta	DRAG	DRAG INCREMENT DUE TO RIGHT AILERON DEFLECTION
CFXDRD	alpha,beta	DRAG	DRAG INCREMENT DUE TO RUDDER DEFLECTION
CFXDSM	alpha,slats	DRAG	DRAG INCREMENT DUE TO SLATS
CFXDSPL	alpha,spoiler-left	DRAG	DRAG INCREMENT DUE TO SPOILERS LEFT
CFXDSPR	alpha,spoiler-right	DRAG	DRAG INCREMENT DUE TO SPOILERS RIGHT
CFZB	alpha,elevator	LIFT	BASE LIFT
CFZDFM	alpha,flaps	LIFT	LIFT INCREMENT DUE TO FLAPS
CFZGEAR	alpha	LIFT	LIFT INCREMENT DUE TO GEAR
CFZDADL	alpha,beta	LIFT	LIFT INCREMENT DUE TO LEFT AILERON DEFLECTION
CFZMN	mach,alpha	LIFT	LIFT INCREMENT DUE TO MACH
CFZDDS	alpha,stabilator	LIFT	LIFT INCREMENT DUE TO PITCH TRIM
CFZDADR	alpha,beta	LIFT	LIFT INCREMENT DUE TO RIGHT AILERON DEFLECTION
CFZDRD	alpha,beta	LIFT	LIFT INCREMENT DUE TO RUDDER DEFLECTION
CFZDSM	alpha,slats	LIFT	LIFT INCREMENT DUE TO SLATS
CFZDSPL	alpha,spoiler-left	LIFT	LIFT INCREMENT DUE TO SPOILERS LEFT
CFZDSPR	alpha,spoiler-right	LIFT	LIFT INCREMENT DUE TO SPOILERS RIGHT
CMM1	alpha,elevator	PITCH	BASE PITCHING MOMENT
CMMQ	alpha	PITCH	PITCH DAMPING DERIVATIVE
CMMALPHADOT	alpha	PITCH	PITCH MOMENT DERIVATIVE FOR ALPHA DOT
CMMBETADOT	alpha	PITCH	PITCH MOMENT DERIVATIVE FOR BETA DOT
CMDADL	alpha,beta	PITCH	PITCH MOMENT DUE TO LEFT AILERON DEFLECTION
CMDADR	alpha,beta	PITCH	PITCH MOMENT DUE TO RIGHT AILERON DEFLECTION
CMDRD	alpha,beta	PITCH	PITCH MOMENT DUE TO RUDDER DEFLECTION
CMDFM	alpha,flaps	PITCH	PITCHING MOMENT INCREMENT DUE TO FLAPS
CMMGEAR	alpha	PITCH	PITCHING MOMENT INCREMENT DUE TO GEAR

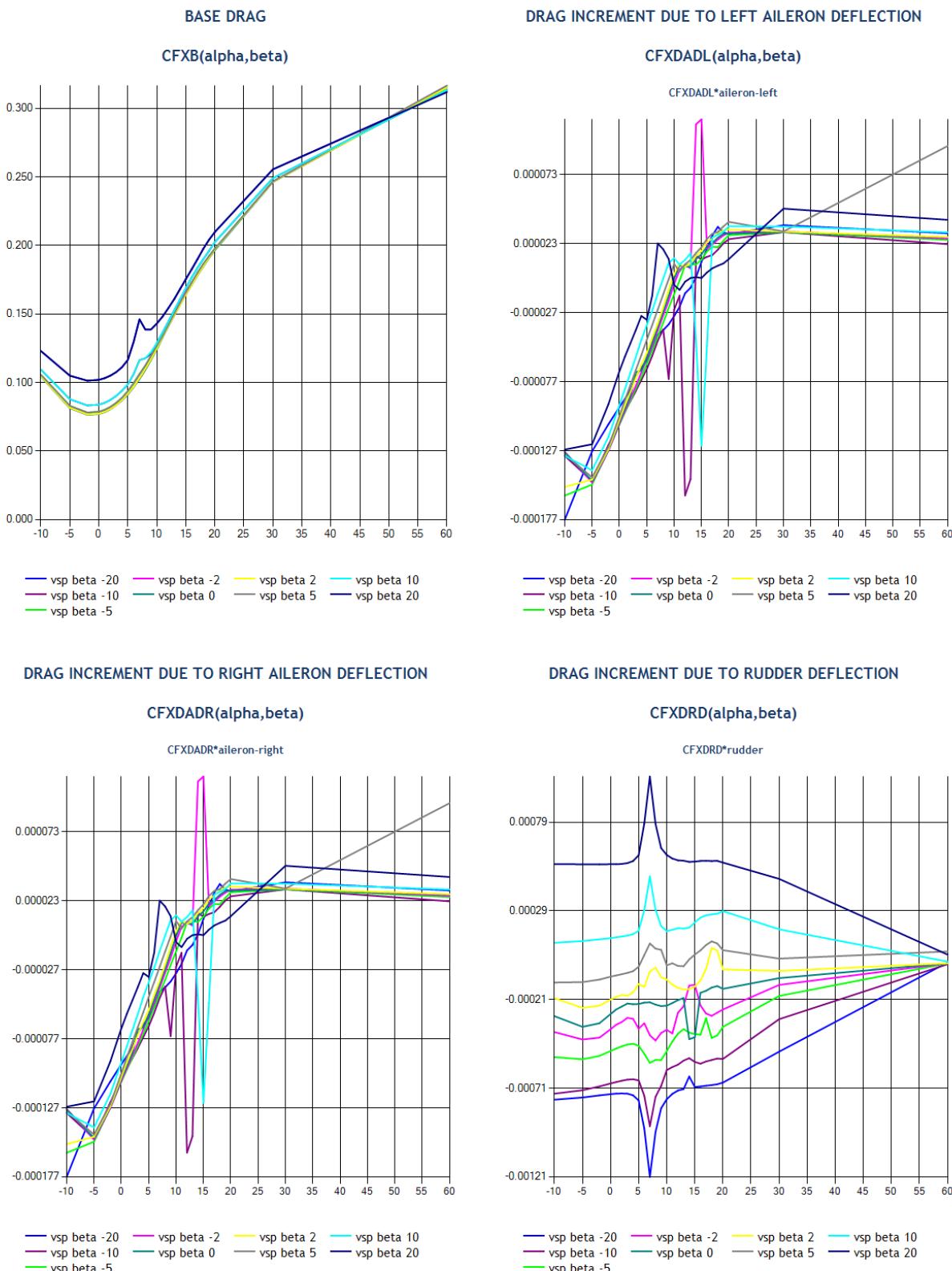
CMMMN	mach,alpha	PITCH	PITCHING MOMENT INCREMENT DUE TO MACH
CMMDDS	alpha,stabilator	PITCH	PITCHING MOMENT INCREMENT DUE TO PITCH TRIM
CMMDSM	alpha,slats	PITCH	PITCHING MOMENT INCREMENT DUE TO SLATS
CMMDSPL	alpha,spoiler-left	PITCH	PITCHING MOMENT INCREMENT DUE TO SPOILERS LEFT
CMMDSPR	alpha,spoiler-right	PITCH	PITCHING MOMENT INCREMENT DUE TO SPOILERS RIGHT
CML1	alpha,beta	ROLL	BASE ROLLING MOMENT
CMLP	alpha	ROLL	ROLL DAMPING DERIVATIVE
CMLBETADOT	alpha	ROLL	ROLL MOMENT DERIVATIVE FOR BETA DOT
CMLDADL	alpha,beta	ROLL	ROLLING MOMENT DUE TO LEFT AILERON DEFLECTION
CMLDADR	alpha,beta	ROLL	ROLLING MOMENT DUE TO RIGHT AILERON DEFLECTION
CMLDRD	alpha,beta	ROLL	ROLLING MOMENT DUE TO RUDDER DEFLECTION
CMLR	alpha	ROLL	ROLLING MOMENT DUE TO YAW RATE
CMLDSPL	alpha,spoiler-left	ROLL	ROLLING MOMENT INCREMENT DUE TO SPOILERS LEFT
CMLDSPR	alpha,spoiler-right	ROLL	ROLLING MOMENT INCREMENT DUE TO SPOILERS RIGHT
CFYB	alpha,beta,elevator	SIDE	BASE SIDEFORCE
CYDADL	alpha,beta	SIDE	SIDE FORCE DUE TO LEFT AILERON DEFLECTION
CYDADR	alpha,beta	SIDE	SIDE FORCE DUE TO RIGHT AILERON DEFLECTION
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
CFYDSPL	alpha,spoiler-left	SIDE	SIDEFORCE INCREMENT DUE TO SPOILERS LEFT
CFYDSPR	alpha,spoiler-right	SIDE	SIDEFORCE INCREMENT DUE TO SPOILERS RIGHT
CMN1	alpha	YAW	BASE YAWING MOMENT
CMNR	alpha	YAW	YAW DAMPING DERIVATIVE
CMNBETADOT	alpha	YAW	YAW MOMENT DERIVATIVE FOR BETA DOT
CMNP	alpha	YAW	YAW MOMENT DUE TO ROLL RATE
CMNDADL	alpha,beta	YAW	YAWING MOMENT DUE TO LEFT AILERON DEFLECTION
CMNDADR	alpha,beta	YAW	YAWING MOMENT DUE TO RIGHT AILERON DEFLECTION
CMNDRD	alpha,beta	YAW	YAWING MOMENT DUE TO RUDDER DEFLECTION
CMNDED	alpha,elevator	YAW	YAWING MOMENT INCREMENT DUE TO ELEVATOR
CMNDSP	alpha,spoiler-left	YAW	YAWING MOMENT INCREMENT DUE TO SPOILERS LEFT
CMNDSPR	alpha,spoiler-right	YAW	YAWING MOMENT INCREMENT DUE TO SPOILERS RIGHT

## Coefficient Buildup

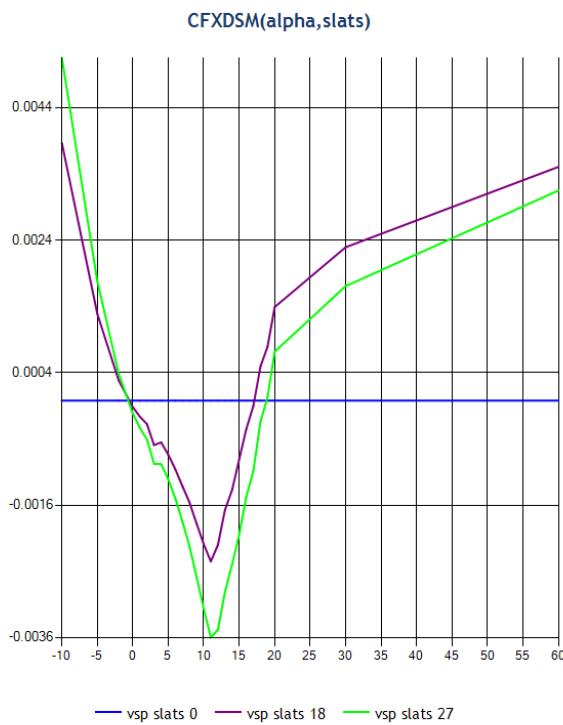
Axis	Buildup
DRAG	CFXB + CFXDADL*aileron-left + CFXDADR*aileron-right + CFXDRD*rudder + CFXDSM + CFXDFM + CFXDSP + CFXDSPR + CFXGEAR*gear + CFXMN
ROLL	CML1 + CMLDADL*aileron-left + CMLDADR*aileron-right + CMLDRD*rudder + CMLDSP + CMLDSPR + CMLBETADOT*aero/bi2vel*BETADOT + CMLP*PB + CMLR*RB

SIDE	$CYDADL^*\text{aileron-left} + CYDADR^*\text{aileron-right} + CYDRD^*\text{rudder} + CFYDSPL + CFYDSPR + CFYB + CFYP^*\text{PB} + CFYR^*\text{RB}$
LIFT	$CFZDADL^*\text{aileron-left} + CFZDADR^*\text{aileron-right} + CFZDRD^*\text{rudder} + CFZDSM + CFZDFM + CFZDSPL + CFZDSPR + CFZGEAR^*\text{gear} + CFZB + CFZDDS + CFZMN$
PITCH	$CMMDDL^*\text{aileron-left} + CMMDDR^*\text{aileron-right} + CMMRD^*\text{rudder} + CMMDSM + CMMDFM + CMMDSPL + CMMDSPR + CMMGEAR^*\text{gear} + CMM1 + CMMDDS + CMMMN + CMMALPHADOT^*\text{aero/ci2vel}^*\text{ALPHADOT} + CMBETADOT^*\text{aero/ci2vel}^*\text{BETADOT} + CMMQ^*\text{QB}$
YAW	$CMNDADL^*\text{aileron-left} + CMNDADR^*\text{aileron-right} + CMNDRD^*\text{rudder} + CMNDSPR + CMN1^*\text{beta} + CMNDED^*\text{beta} + CMNBETADOT^*\text{aero/bi2vel}^*\text{BETADOT} + CMNR^*\text{RB} + CMNP^*\text{PB}$

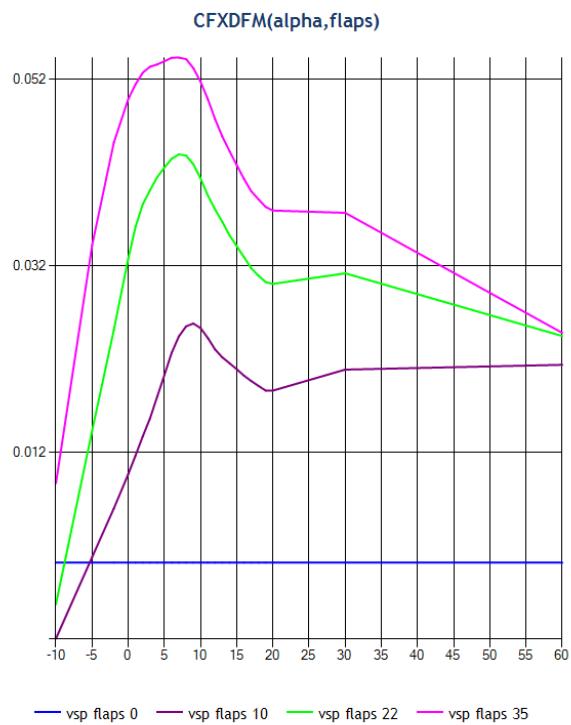
## DRAG



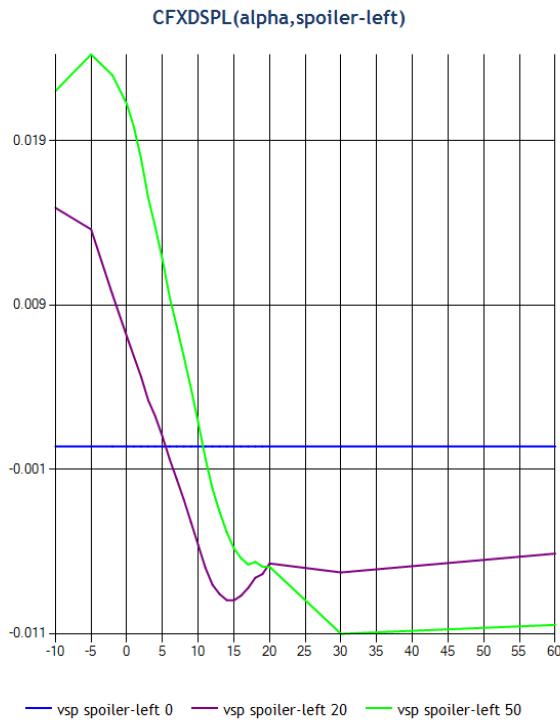
DRAG INCREMENT DUE TO SLATS



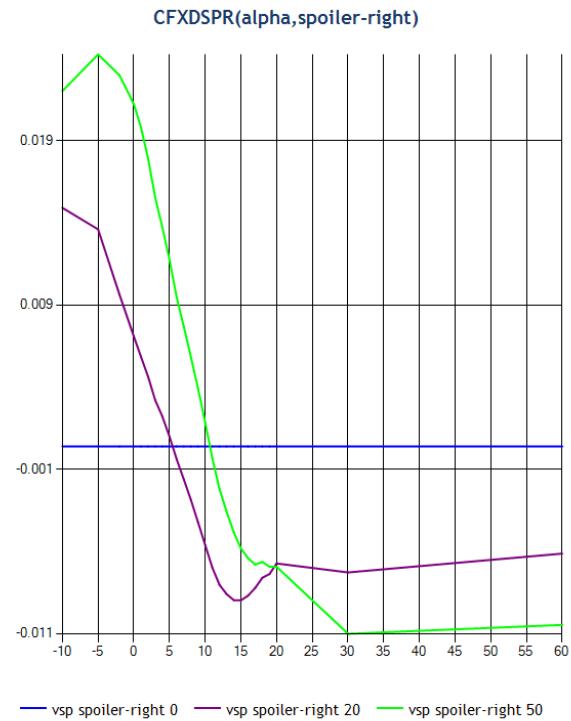
DRAG INCREMENT DUE TO FLAPS



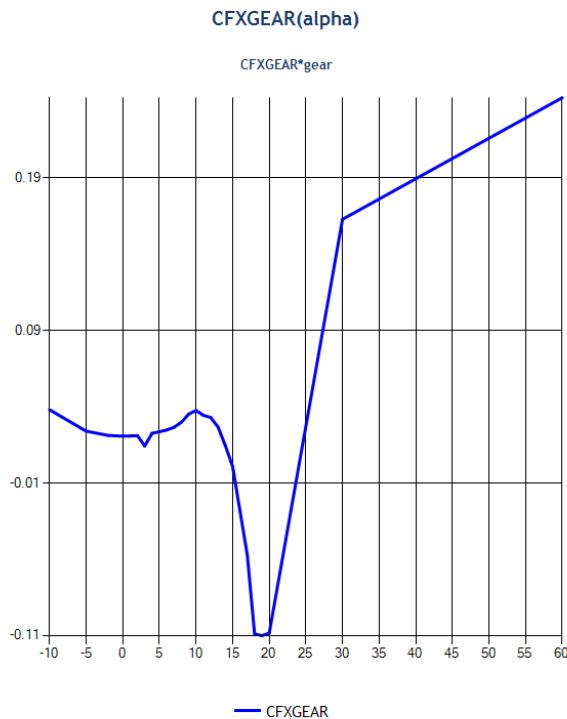
DRAG INCREMENT DUE TO SPOILERS LEFT



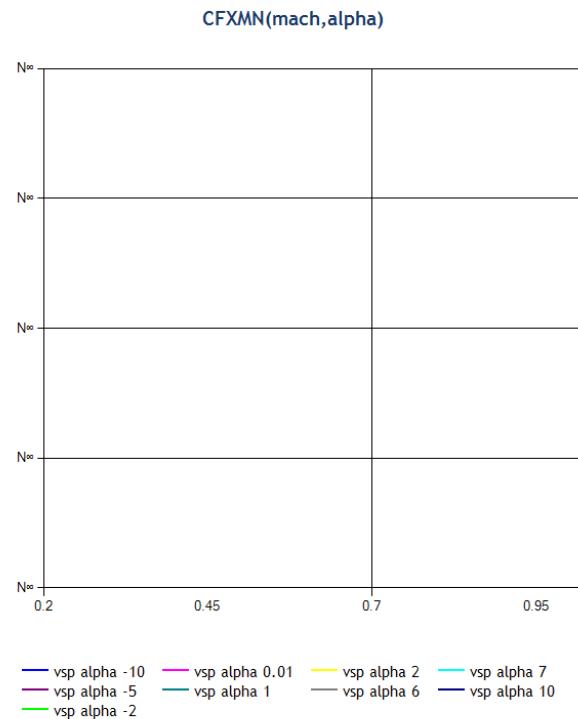
DRAG INCREMENT DUE TO SPOILERS RIGHT



DRAG INCREMENT DUE TO GEAR

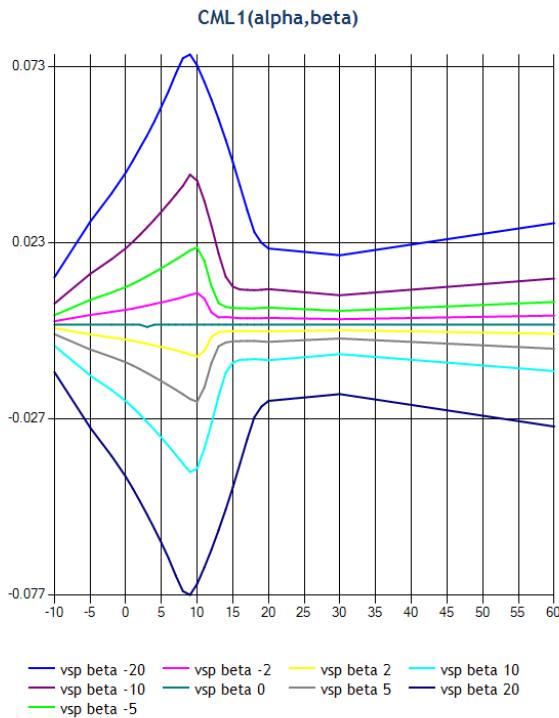


DRAG INCREMENT DUE TO MACH

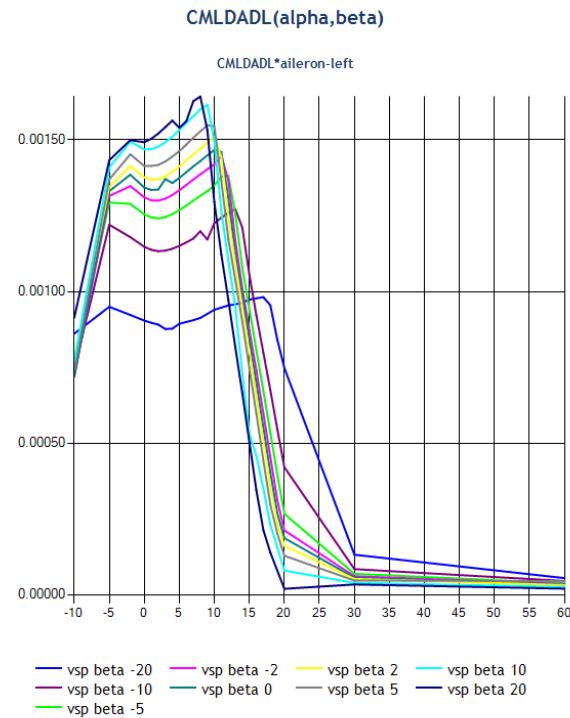


## ROLL

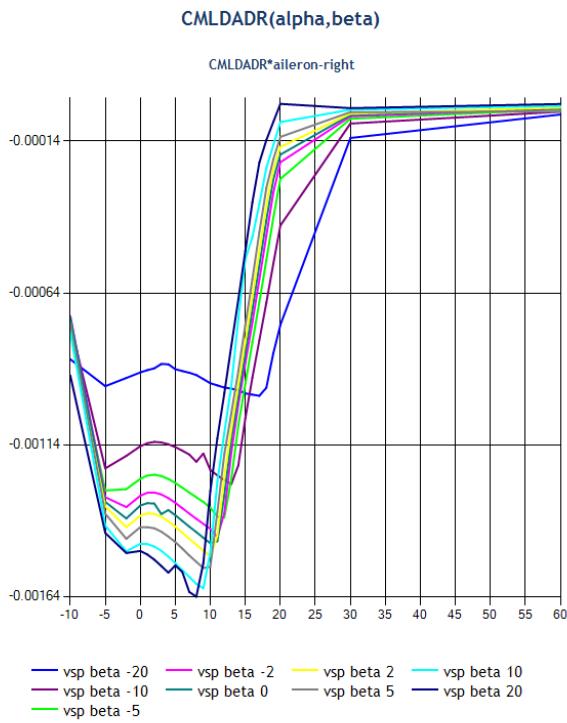
BASE ROLLING MOMENT



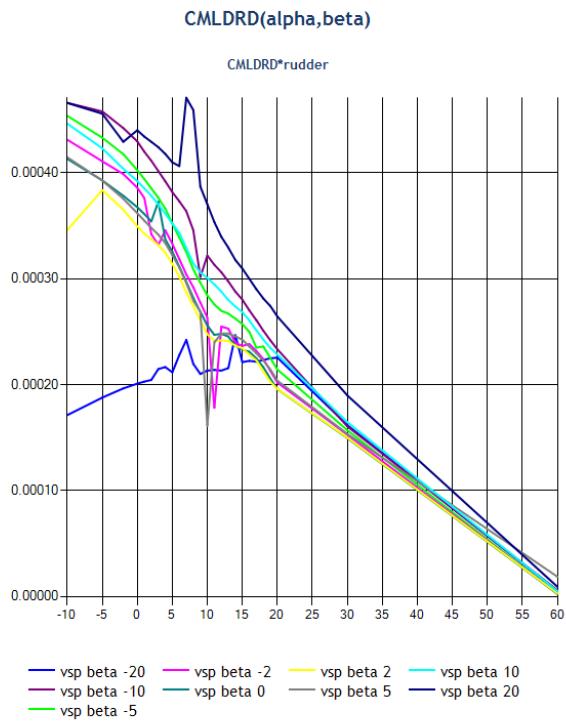
ROLLING MOMENT DUE TO LEFT AILERON DEFLECTION



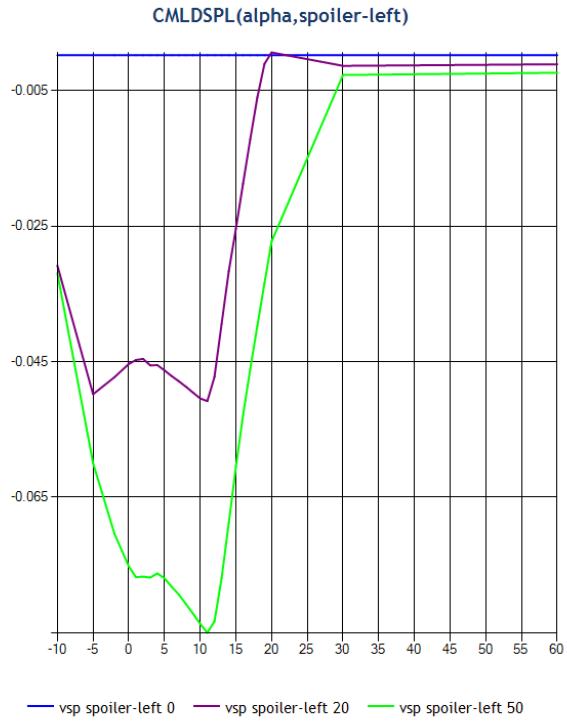
### ROLLING MOMENT DUE TO RIGHT AILERON DEFLECTION



### ROLLING MOMENT DUE TO RUDDER DEFLECTION



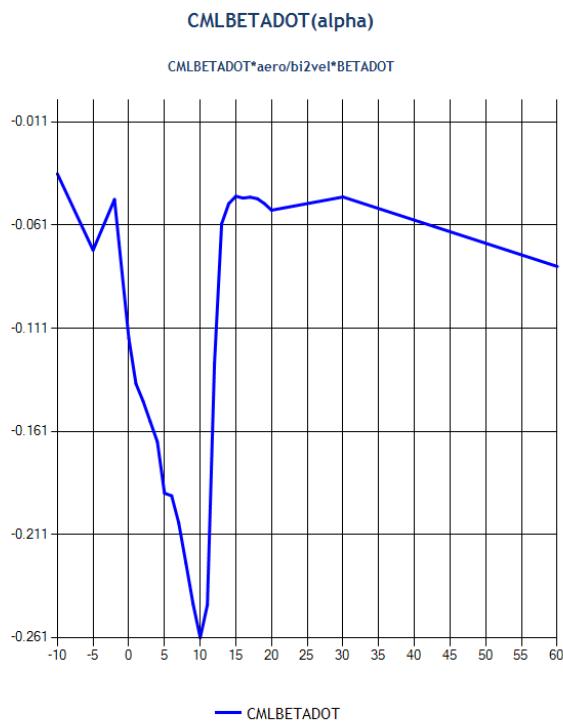
### ROLLING MOMENT INCREMENT DUE TO SPOILERS LEFT



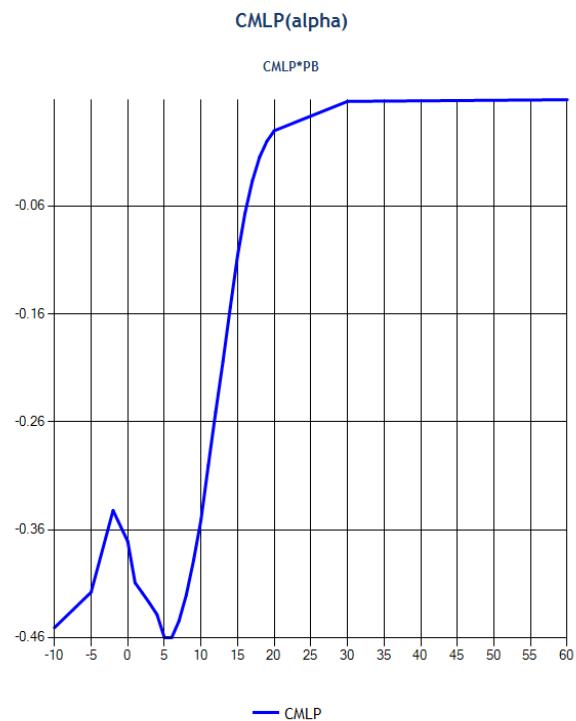
### ROLLING MOMENT INCREMENT DUE TO SPOILERS RIGHT



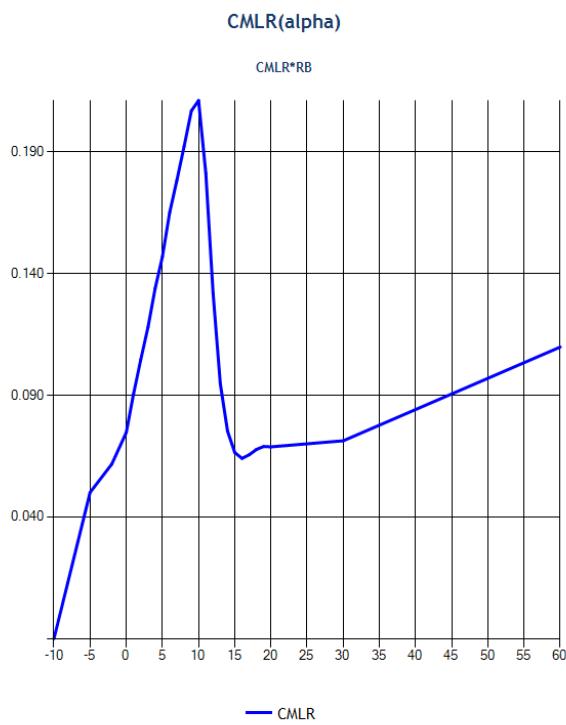
### ROLL MOMENT DERIVATIVE FOR BETA DOT



### ROLL DAMPING DERIVATIVE



### ROLLING MOMENT DUE TO YAW RATE

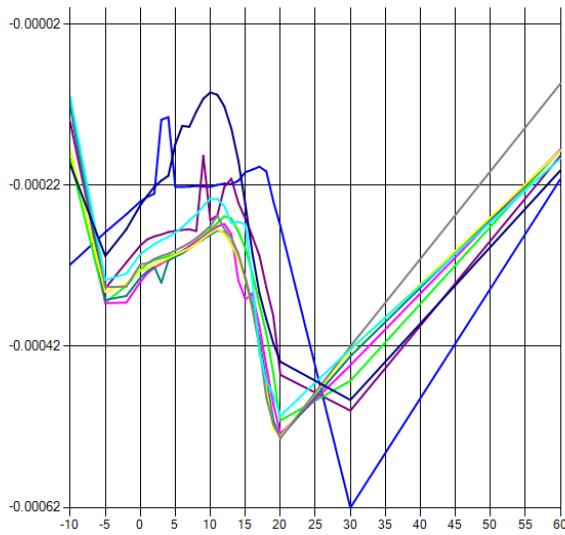


SIDE

### SIDE FORCE DUE TO LEFT AILERON DEFLECTION

CYDADL(alpha,beta)

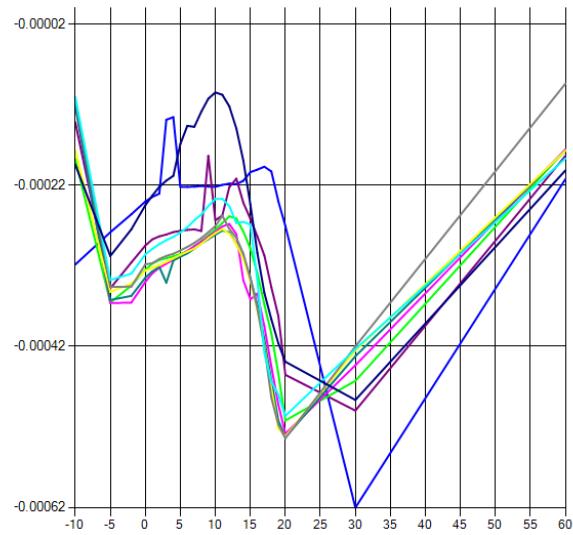
CYDADL\*aileron-left



### SIDE FORCE DUE TO RIGHT AILERON DEFLECTION

CYDADR(alpha,beta)

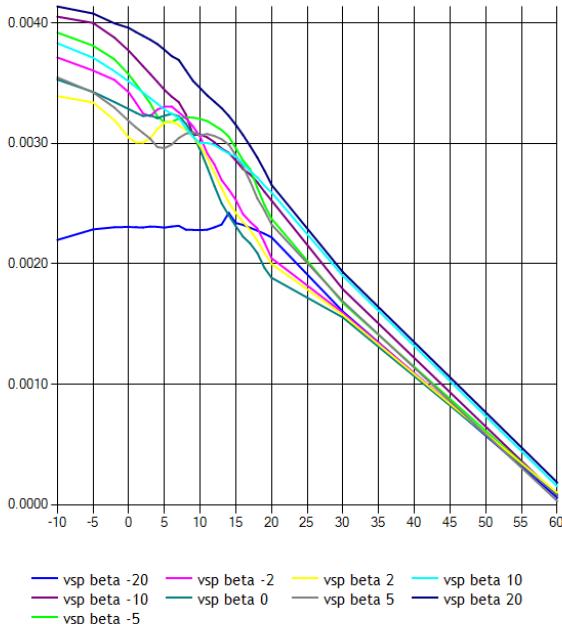
CYDADR\*aileron-right



### SIDE FORCE DUE TO RUDDER DEFLECTION

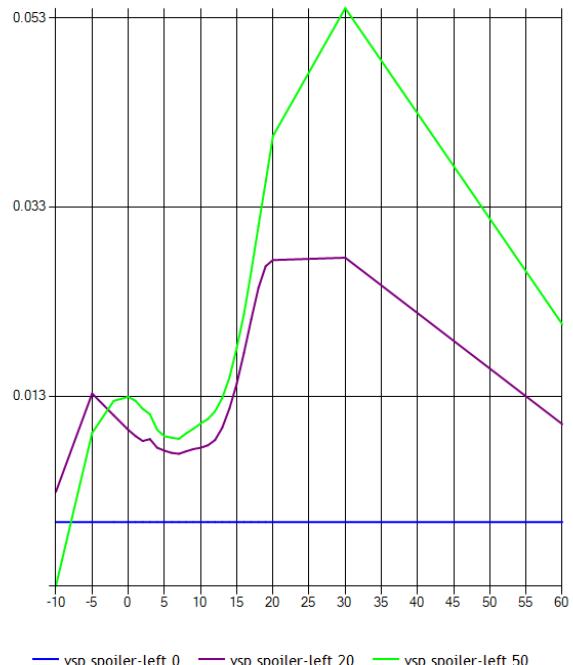
CYDRD(alpha,beta)

CYDRD\*rudder



### SIDEFORCE INCREMENT DUE TO SPOILERS LEFT

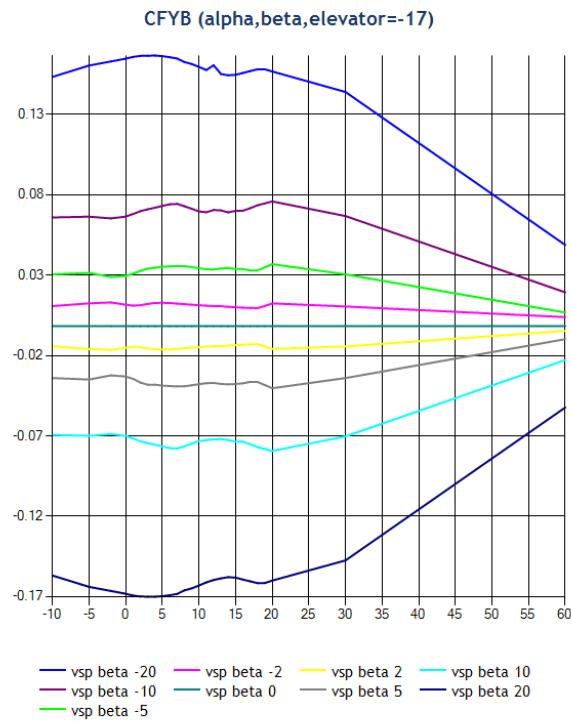
CFYDSPL(alpha,spoiler-left)



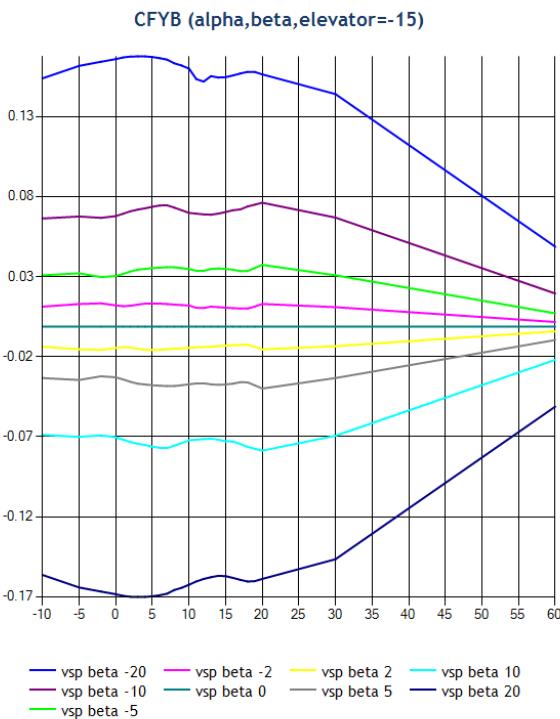
### SIDEFORCE INCREMENT DUE TO SPOILERS RIGHT



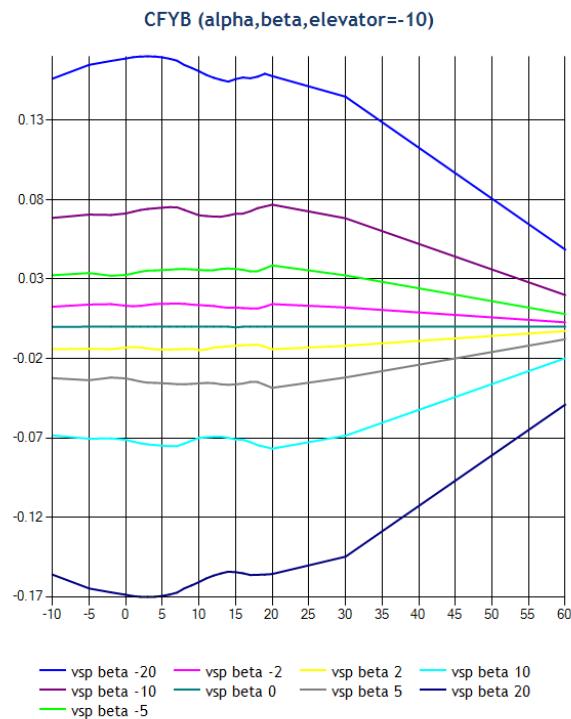
### BASE SIDEFORCE



### BASE SIDEFORCE

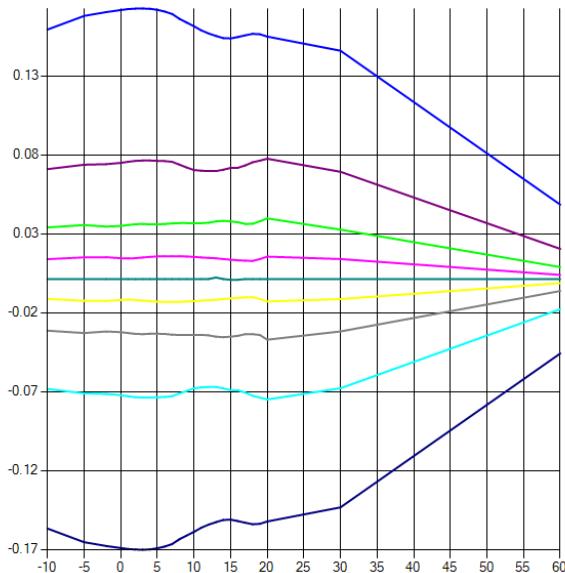


### BASE SIDEFORCE



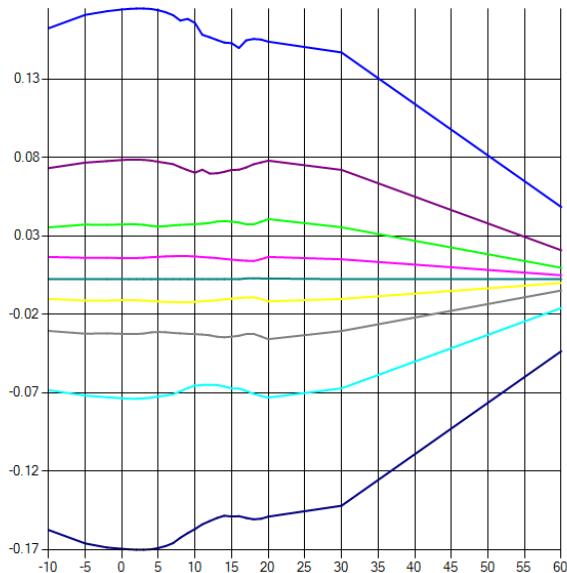
### BASE SIDEFORCE

CFYB (alpha,beta,elevator=-5)



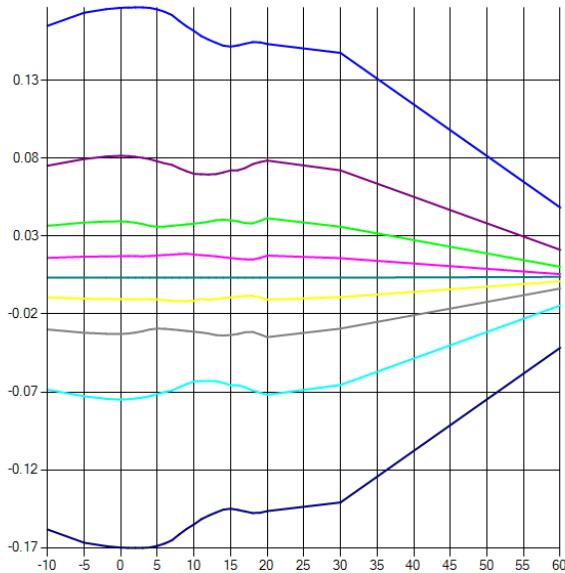
### BASE SIDEFORCE

CFYB (alpha,beta,elevator=0)



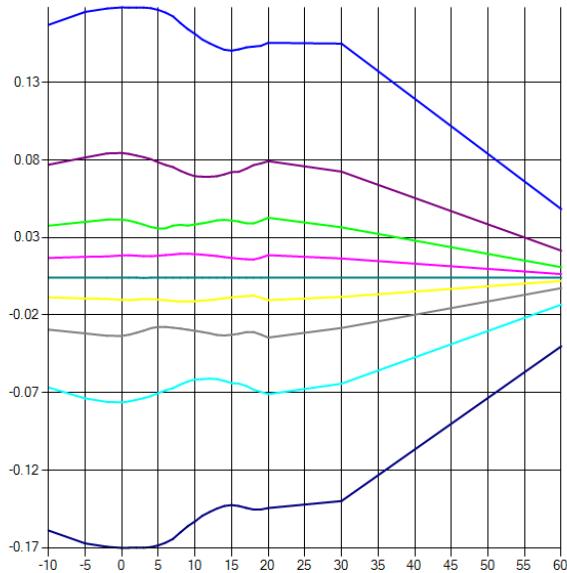
### BASE SIDEFORCE

CFYB (alpha,beta,elevator=5)

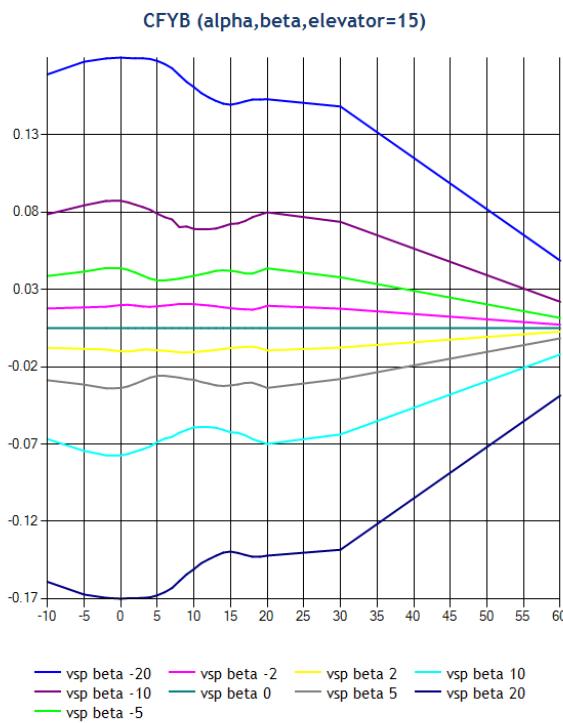


### BASE SIDEFORCE

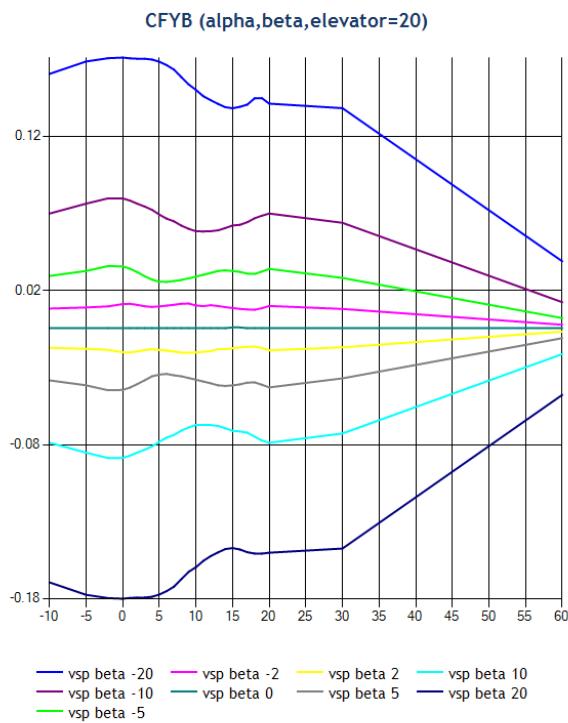
CFYB (alpha,beta,elevator=10)



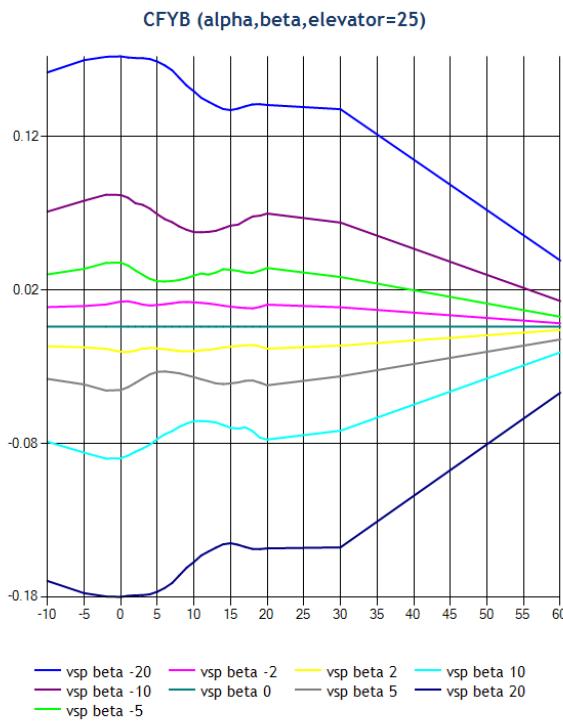
### BASE SIDEFORCE



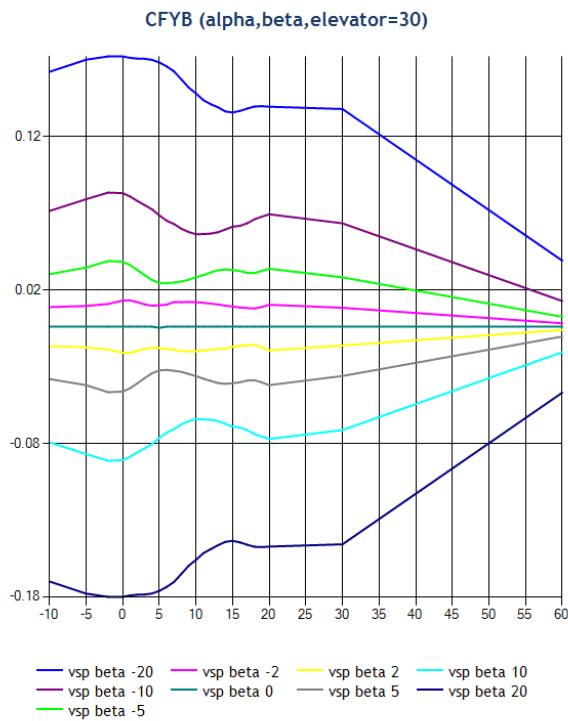
### BASE SIDEFORCE



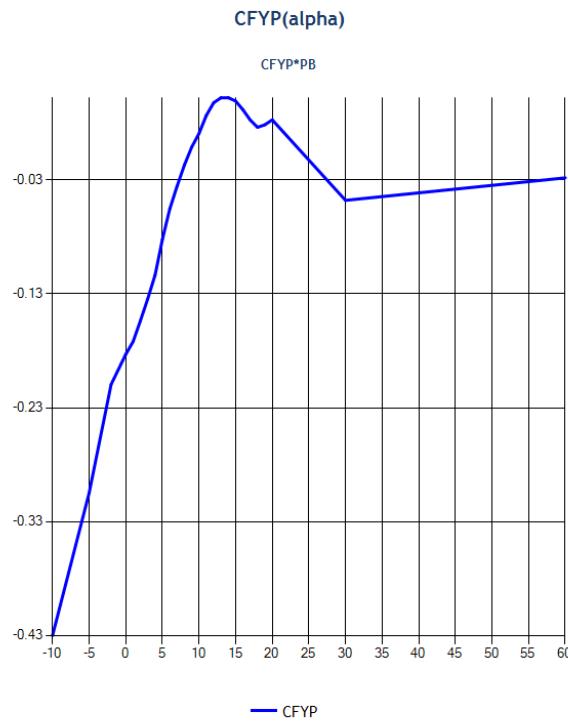
### BASE SIDEFORCE



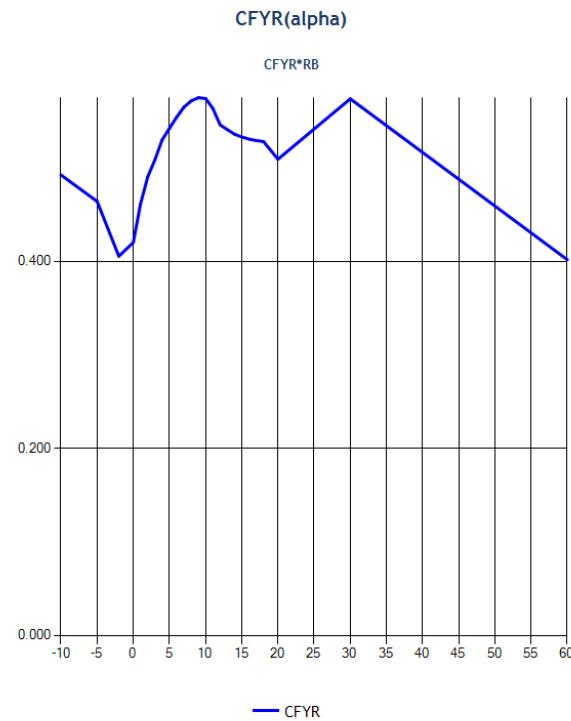
### BASE SIDEFORCE



### SIDE FORCE DUE TO ROLL RATE

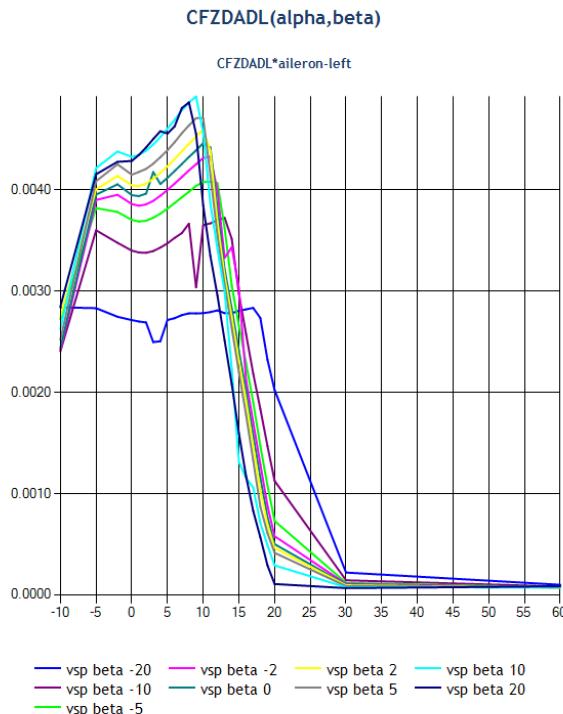


### SIDE FORCE DUE TO YAW RATE

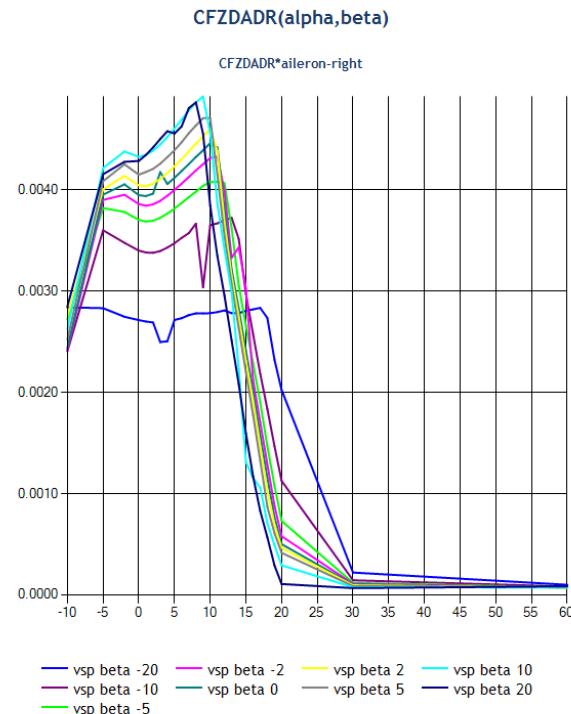


## LIFT

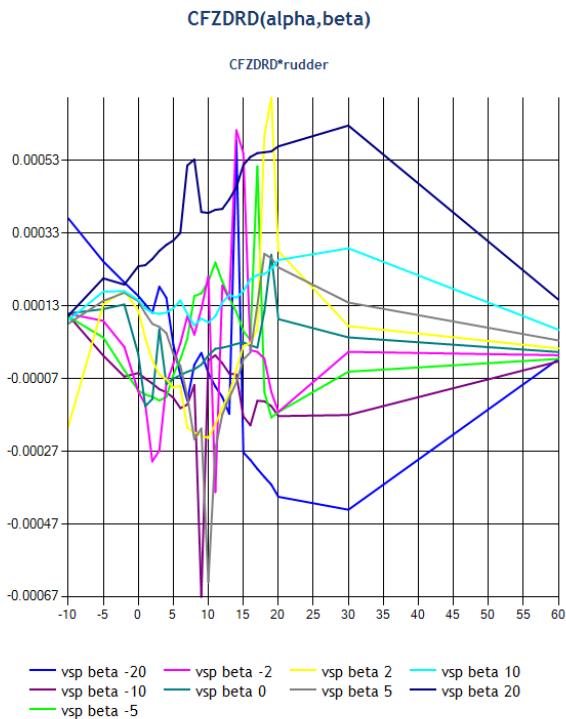
### LIFT INCREMENT DUE TO LEFT AILERON DEFLECTION



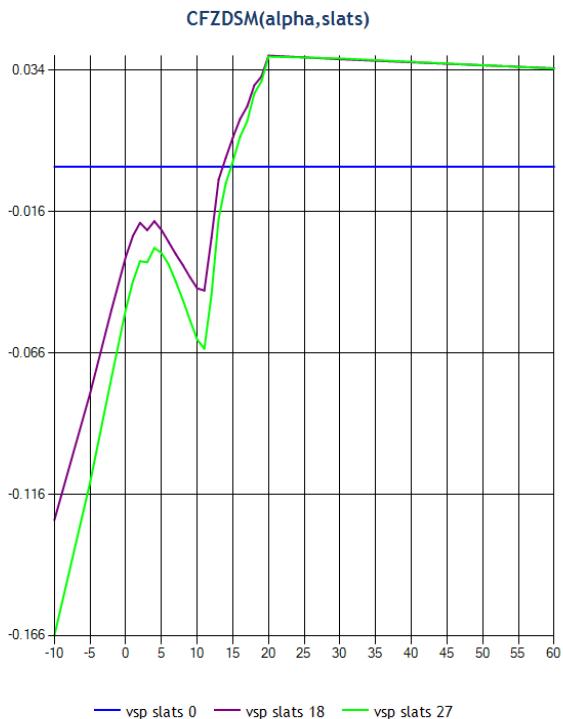
### LIFT INCREMENT DUE TO RIGHT AILERON DEFLECTION



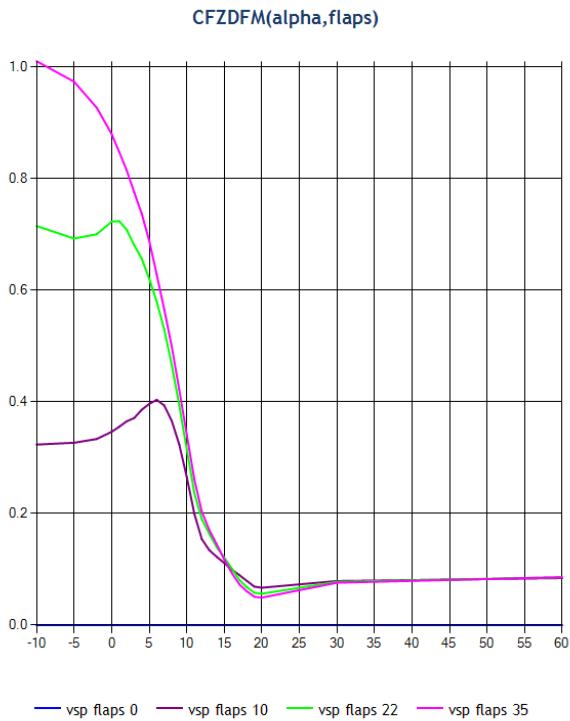
### LIFT INCREMENT DUE TO RUDDER DEFLECTION



### LIFT INCREMENT DUE TO SLATS



### LIFT INCREMENT DUE TO FLAPS



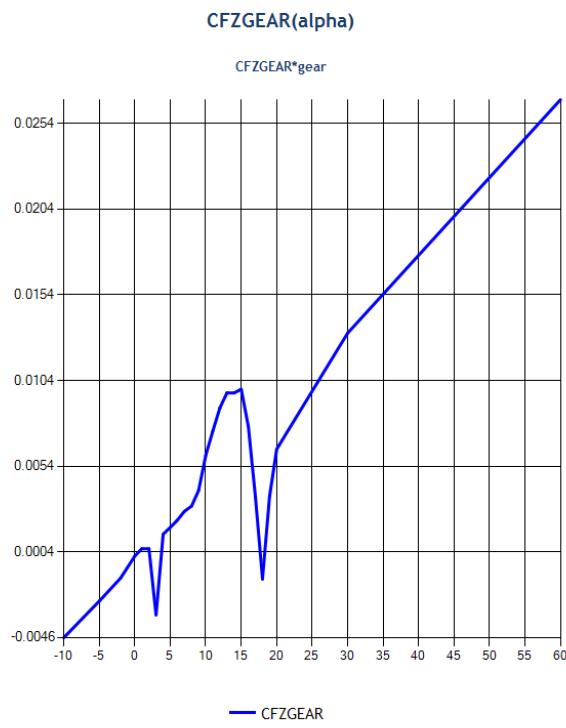
### LIFT INCREMENT DUE TO SPOILERS LEFT



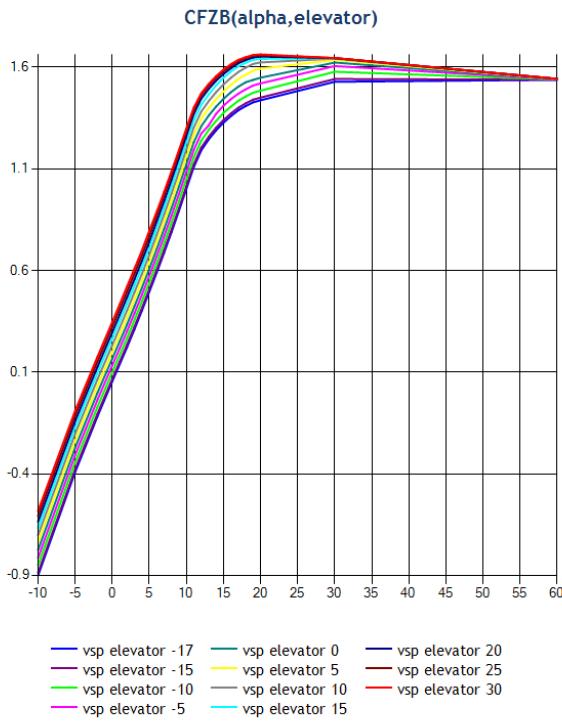
### LIFT INCREMENT DUE TO SPOILERS RIGHT



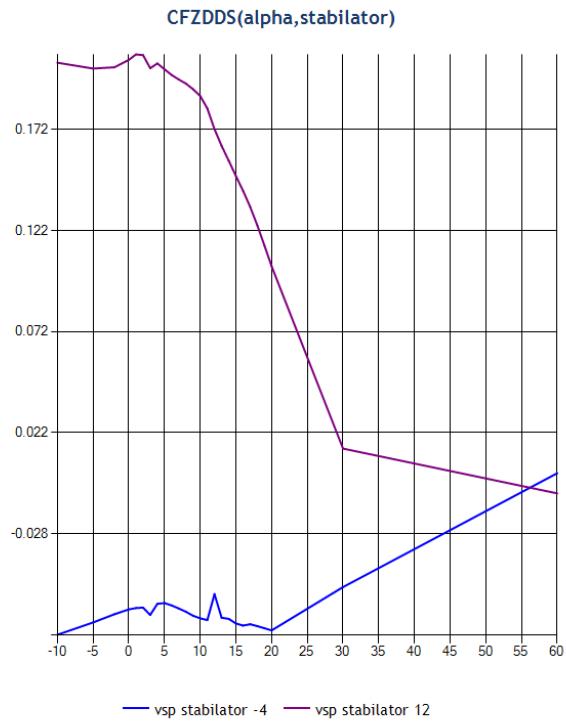
### LIFT INCREMENT DUE TO GEAR



### BASE LIFT

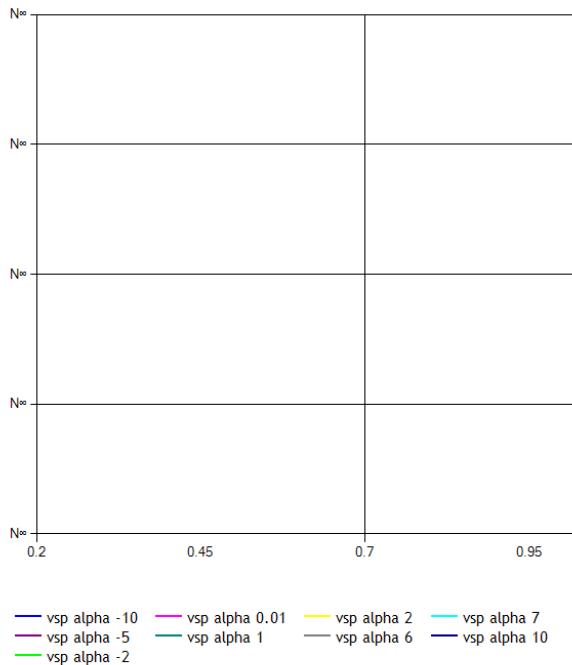


### LIFT INCREMENT DUE TO PITCH TRIM



## LIFT INCREMENT DUE TO MACH

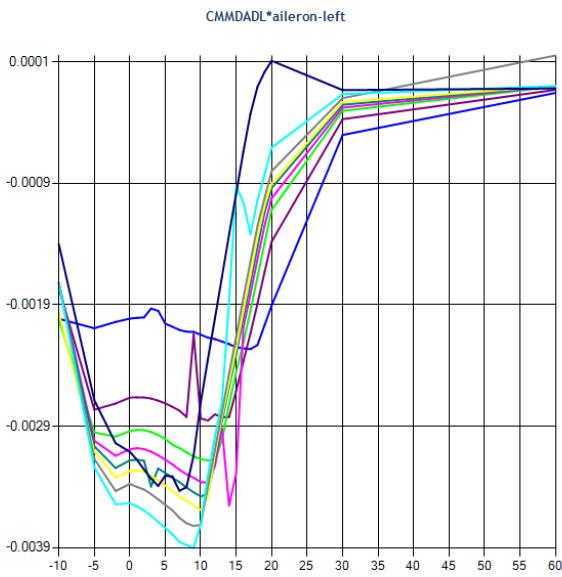
CFZMN(mach,alpha)



## PITCH

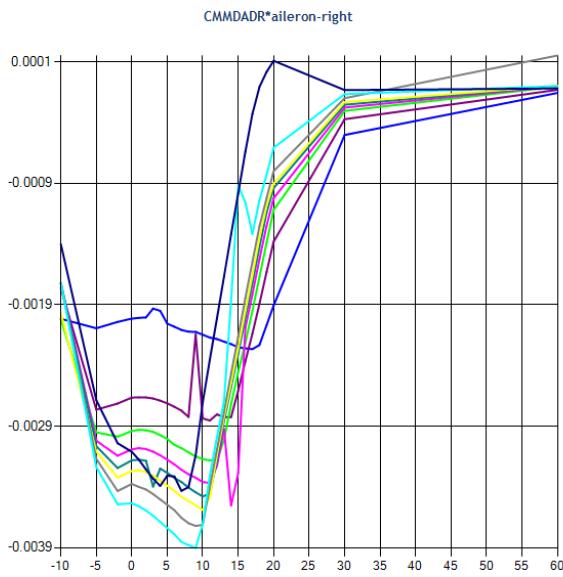
### PITCH MOMENT DUE TO LEFT AILERON DEFLECTION

CMMMDADL(alpha,beta)

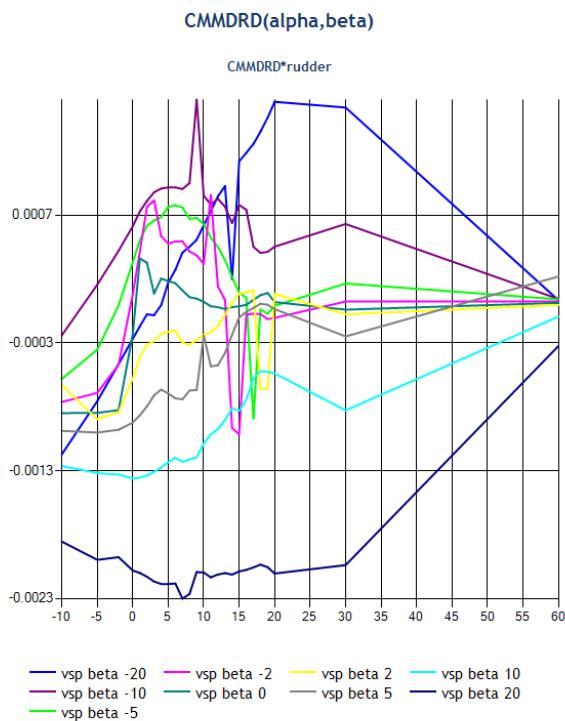


### PITCH MOMENT DUE TO RIGHT AILERON DEFLECTION

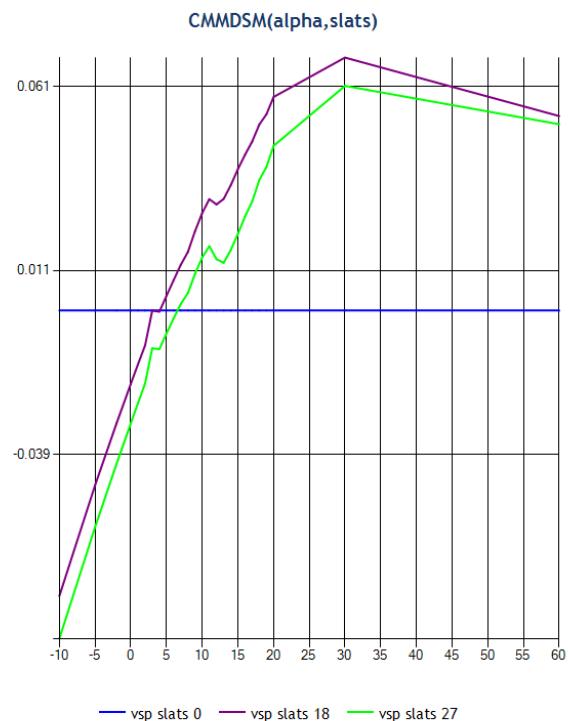
CMMMDADR(alpha,beta)



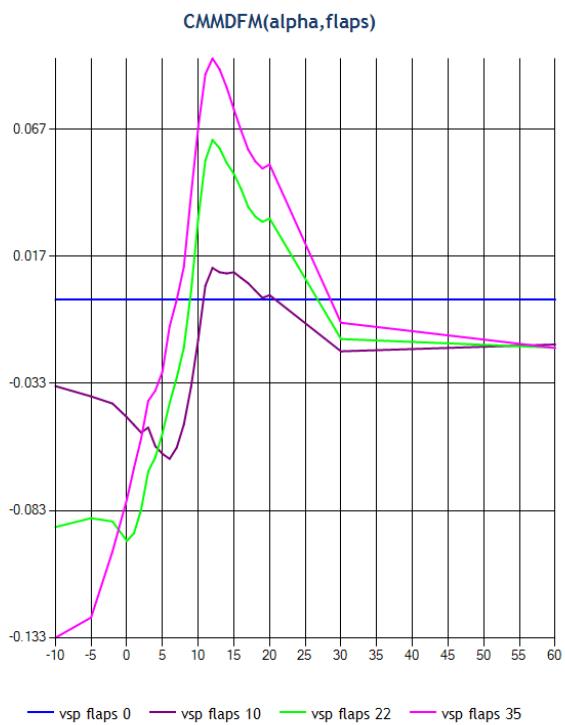
### PITCH MOMENT DUE TO RUDDER DEFLECTION



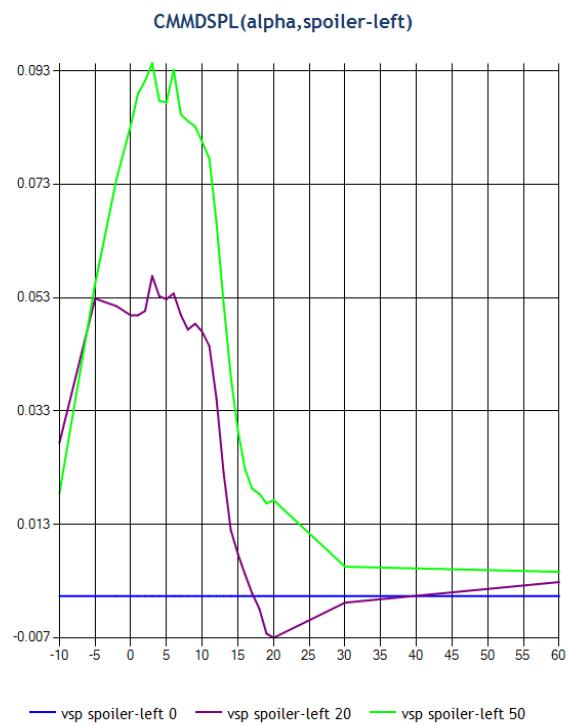
### PITCHING MOMENT INCREMENT DUE TO SLATS



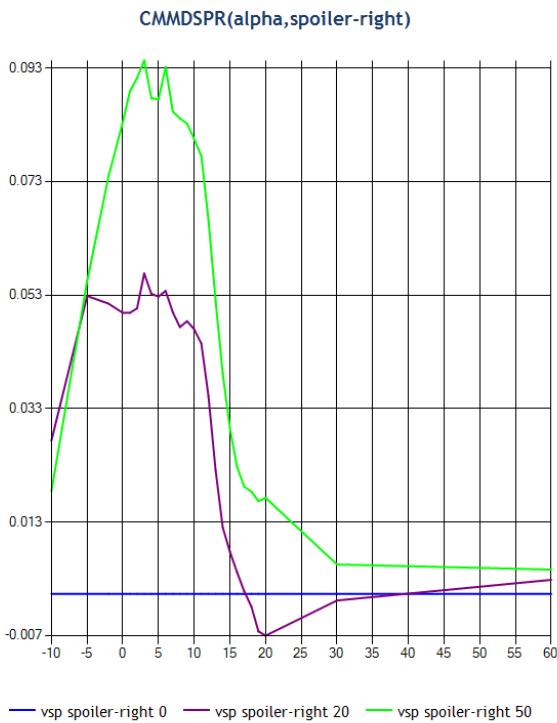
### PITCHING MOMENT INCREMENT DUE TO FLAPS



### PITCHING MOMENT INCREMENT DUE TO SPOILERS LEFT



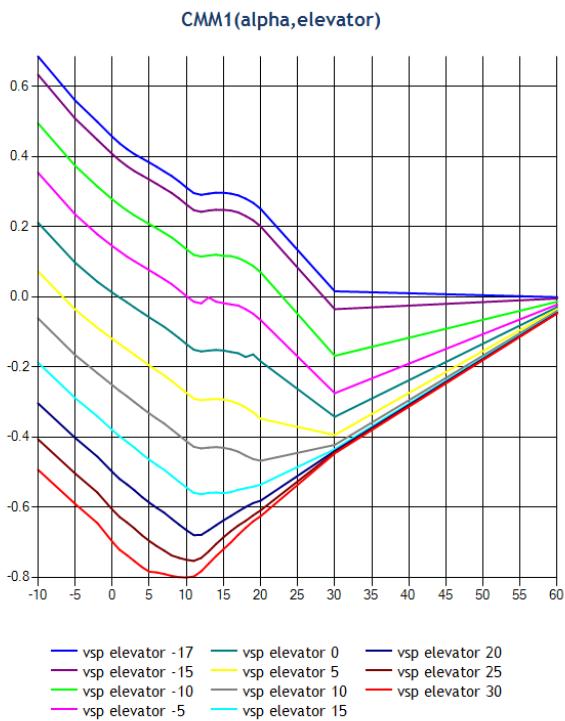
PITCHING MOMENT INCREMENT DUE TO SPOILERS RIGHT



PITCHING MOMENT INCREMENT DUE TO GEAR



BASE PITCHING MOMENT

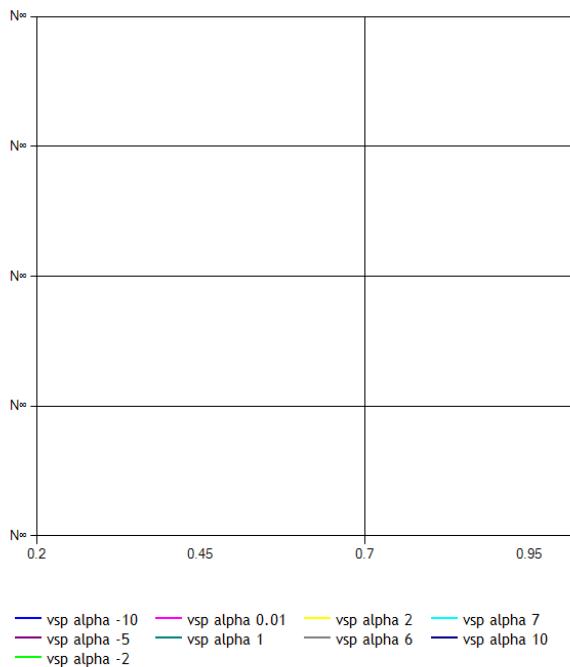


PITCHING MOMENT INCREMENT DUE TO PITCH TRIM



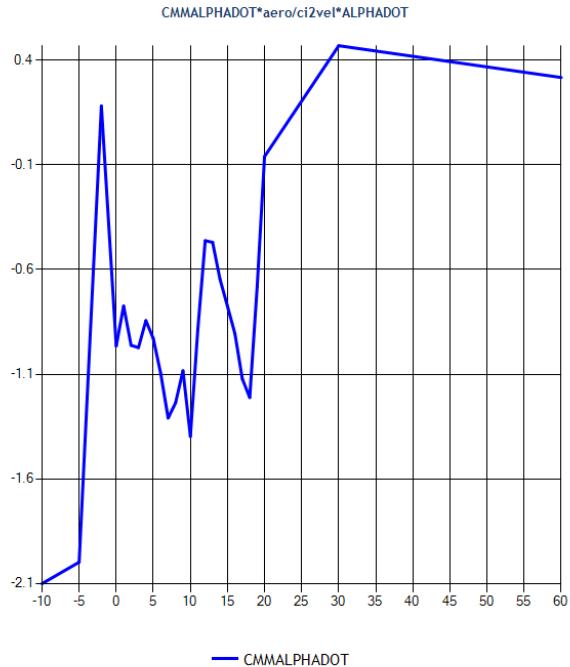
### PITCHING MOMENT INCREMENT DUE TO MACH

CMMMN(mach,alpha)



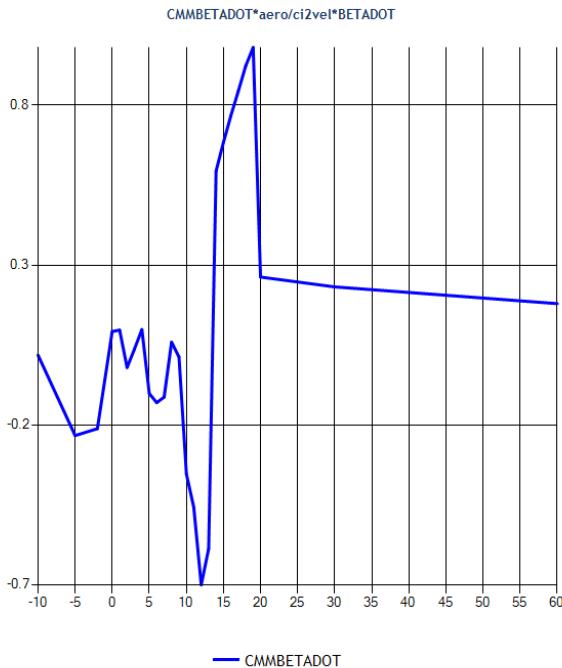
### PITCH MOMENT DERIVATIVE FOR ALPHA DOT

CMMALPHADOT(alpha)



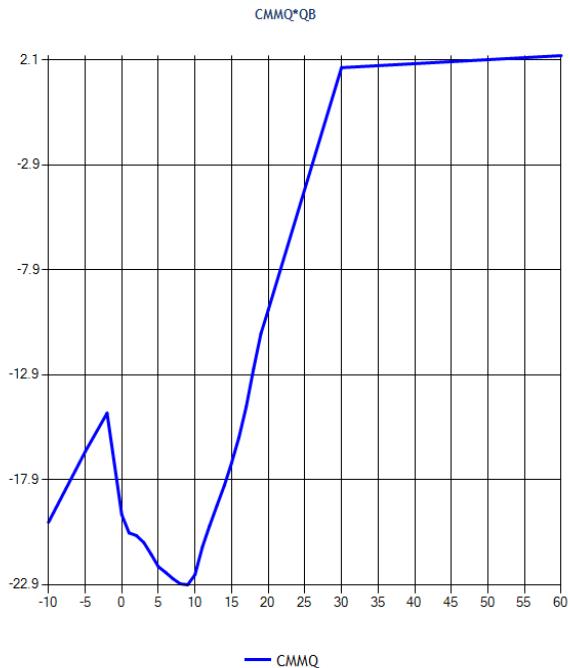
### PITCH MOMENT DERIVATIVE FOR BETA DOT

CMMBETADOT(alpha)



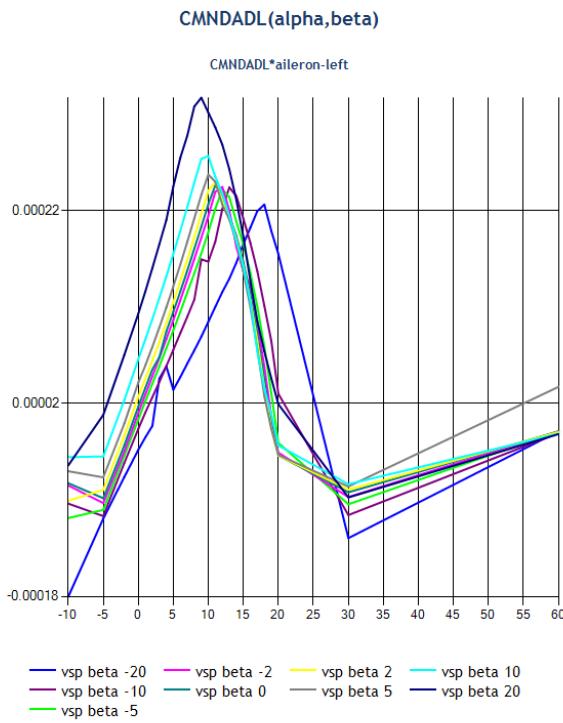
### PITCH DAMPING DERIVATIVE

CMMQ(alpha)

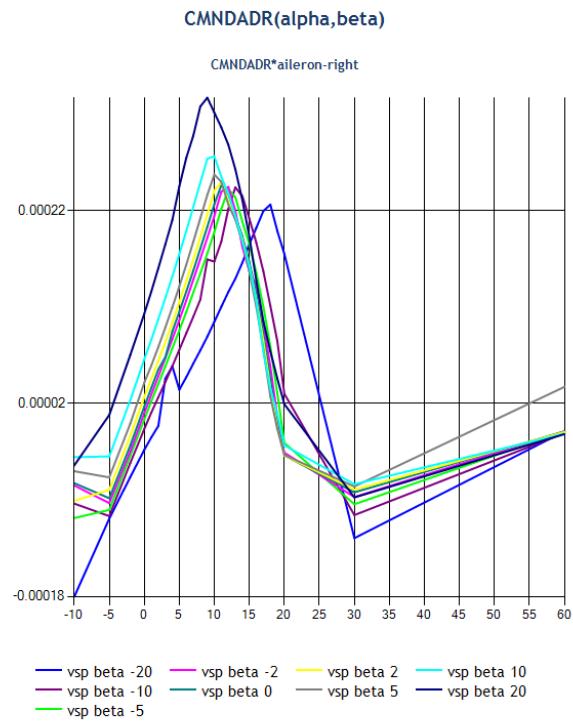


YAW

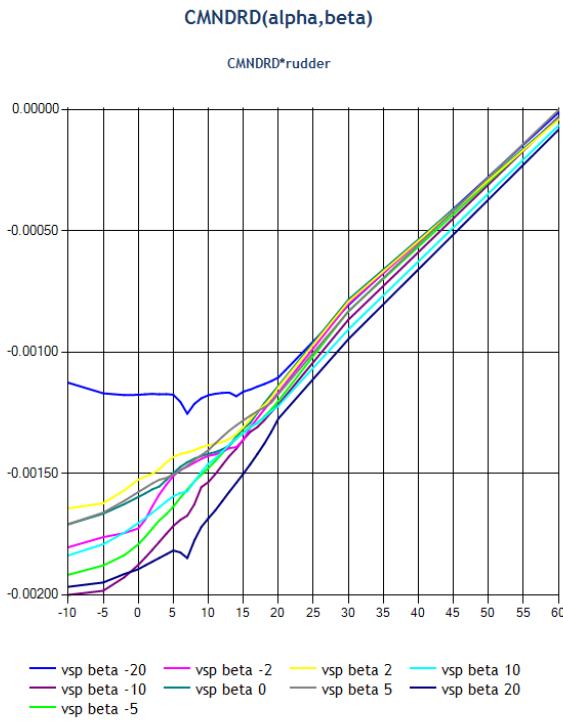
### YAWING MOMENT DUE TO LEFT AILERON DEFLECTION



### YAWING MOMENT DUE TO RIGHT AILERON DEFLECTION



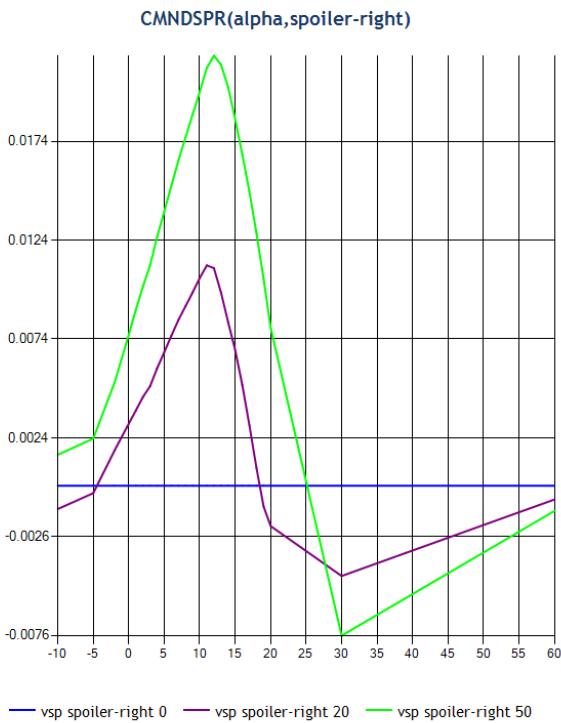
### YAWING MOMENT DUE TO RUDDER DEFLECTION



### YAWING MOMENT INCREMENT DUE TO SPOILERS LEFT



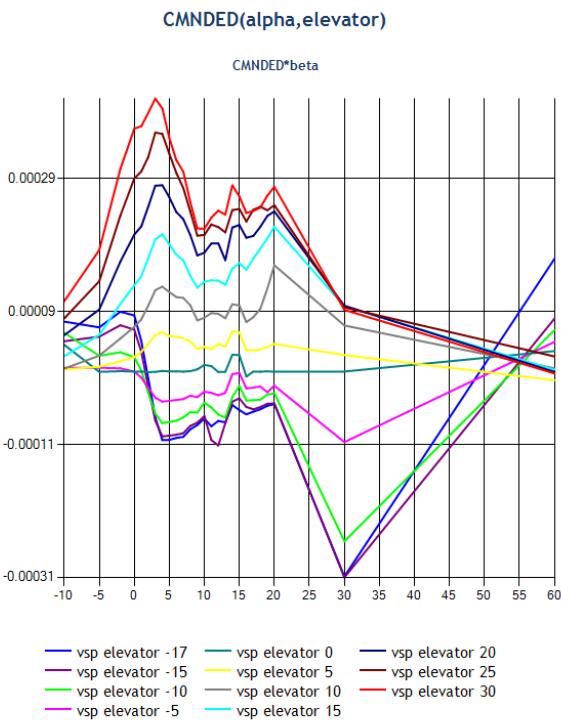
### YAWING MOMENT INCREMENT DUE TO SPOILERS RIGHT



### BASE YAWING MOMENT



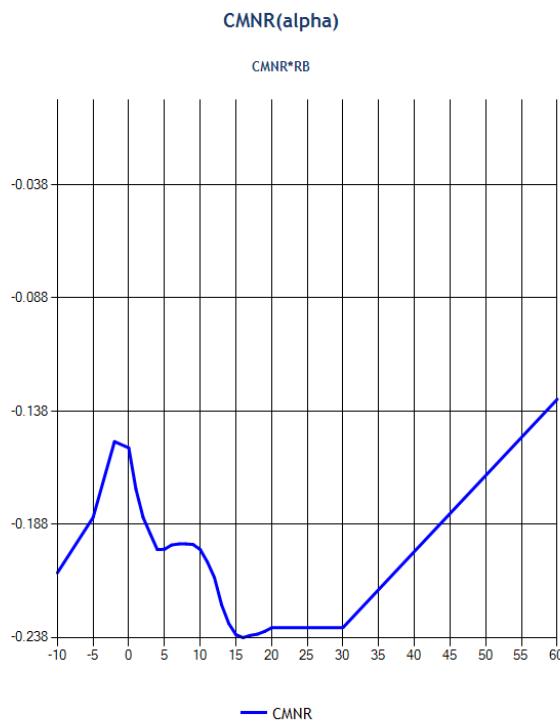
### YAWING MOMENT INCREMENT DUE TO ELEVATOR



### YAW MOMENT DERIVATIVE FOR BETA DOT



### YAW DAMPING DERIVATIVE



### YAW MOMENT DUE TO ROLL RATE



## References

- Richard Harrison, rjh@zaretto.com: A320 200 Aerodynamic data built from vspaero; CG (15.3, 0, 0)M, ZDAT/AED/2018/03-07, March 7, 2018: <http://www.zaretto.com/sites/zaretto.com/files/A320-200-data/rjh-zaretto-A320-200-aerodynamic-data-vspaero.pdf>

## Mass and balance

Element	X	Y	Z	Unit
Aerodynamic Reference Point (CoP)	16.10	0.00	0.00	M
Aircraft CG	15.30	0.00	0.00	M

Element	Unit
I <sub>XX</sub>	SLUG*FT <sup>2</sup>
I <sub>YY</sub>	SLUG*FT <sup>2</sup>
I <sub>ZZ</sub>	SLUG*FT <sup>2</sup>
I <sub>XZ</sub>	SLUG*FT <sup>2</sup>

Element	X	Y	Z	Unit	Weight
AftCargo	24.56	0.00	-1.18	M	3000 LBS
FwdCargo	13.08	0.00	-1.18	M	3000 LBS
PAX	18.82	0.00	0.19	M	23000 LBS
Crew	5.30	0.00	-0.66	M	3800 LBS

## Ground Reactions

Element	X	Y	Z	Unit	Index
NoseGear	7.52	0.00	-4.31	M	0
LeftMainGear	20.32	-4.26	-4.52	M	1

RightMainGear	20.32	4.26	-4.52	M	2
---------------	-------	------	-------	---	---

## Metrics

Element	Unit
Chord	4.82
Wingspan	37.06 M
Wing Area	141.01 M <sup>2</sup>
Wing Incidence	0.00
CIMax	1.60 ND

## Propulsion

Element	X	Y	Z	Unit	Feed
v2527_a5	14.40	-5.76	-1.05	M	CenterTank [0],LeftWing [1],RightWing [2],Engine2Pipes [3],Engine1Pipes [4]
v2527_a5	14.40	5.76	-1.05	M	

## Tanks

Element	X	Y	Z	Unit	Capacity	Id	Priority	Standpipe
CenterTank	18.97	0.00	-0.61	M	14281 LBS	0	1	10 LBS
LeftWing	18.92	-5.11	-0.61	M	13914 LBS	1	1	10 LBS
RightWing	18.92	5.11	-0.61	M	13914 LBS	2	1	10 LBS
Engine2Pipes	18.82	0.00	0.19	M	10 LBS	3	1	10 LBS
Engine1Pipes	18.82	0.00	0.19	M	10 LBS	4	1	10 LBS

## Systems

Name
A320-200-flight-controls

## Independent variables

Name
aero/alpha-deg
aero/alphadot-rad_sec
aero/beta-deg
aero/betadot-rad_sec
aero/bi2vel
aero/ci2vel
aero/pb
aero/qb
aero/rb
fcs/flap-pos-deg

---

fcs/pitch-pos-deg

---

fcs/pitch-trim-pos-deg

---

fcs/roll-pos-left-deg

---

fcs/roll-pos-right-deg

---

fcs/slat-pos-deg

---

fcs/speedbrake-left-deg

---

fcs/speedbrake-right-deg

---

fcs/yaw-pos-deg

---

gear/gear-pos-norm

---

velocities/mach