AePW-2 Preliminary Comparison Data: Case 1, Steady Results

Sept 8, 2015

Data was submitted by analysis teams prior to the Sept 2015 AePW-2 telecon

CONTENTS

- Analysis case matrix
- Tabular form of integrated coefficients and description of analyses
- Plots of CL, CD and Cmy vs. Analysis number (randomly assigned analysis number for this anonymous comparison)
  - Sorted by Grid Resolution (Coarse, Medium, Fine)
  - Sorted by Turbulence Model
  - Sorted by Grid Source (provided, generated)
- Reference and analysis parameter tables

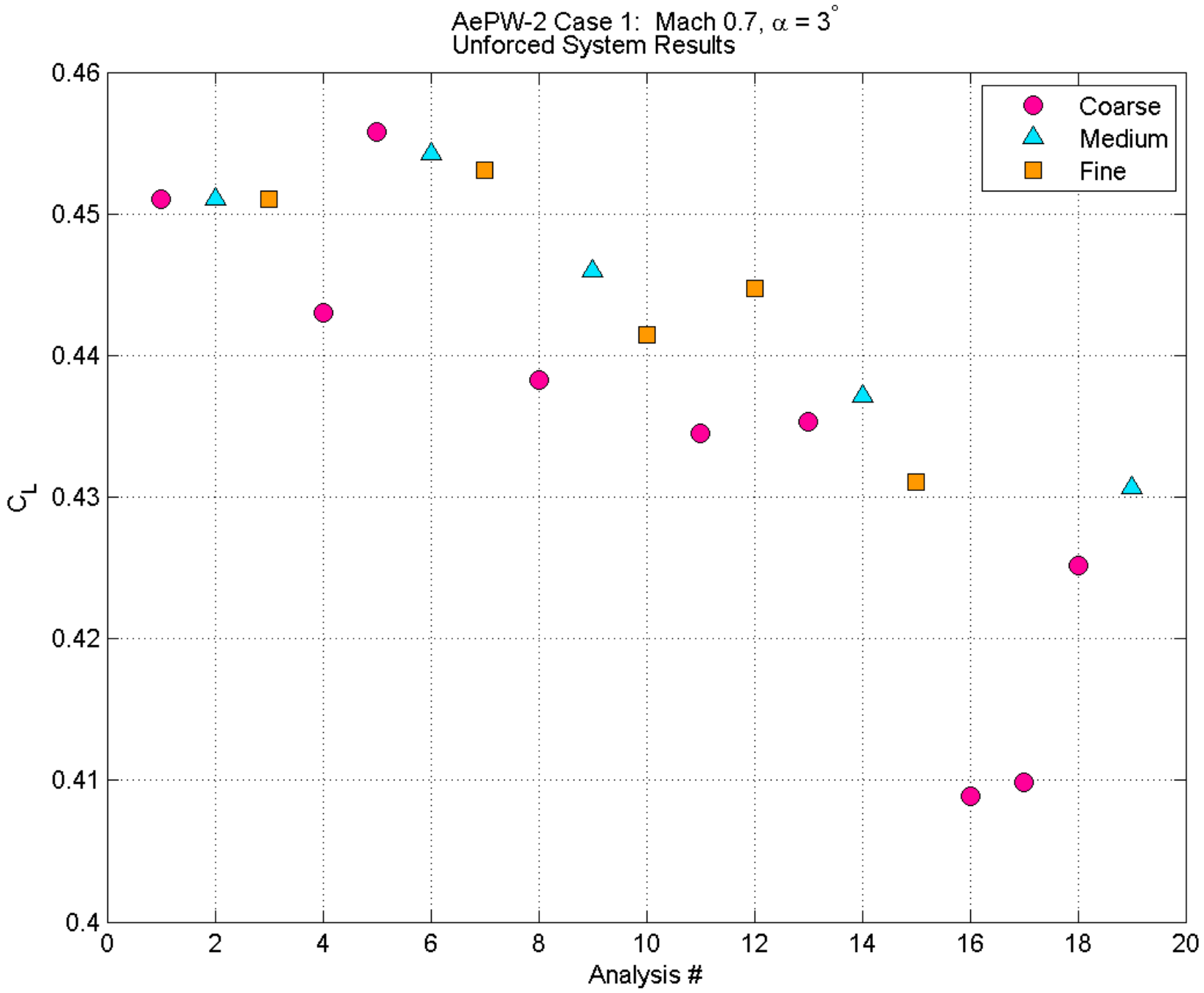
Cases for AePW-2

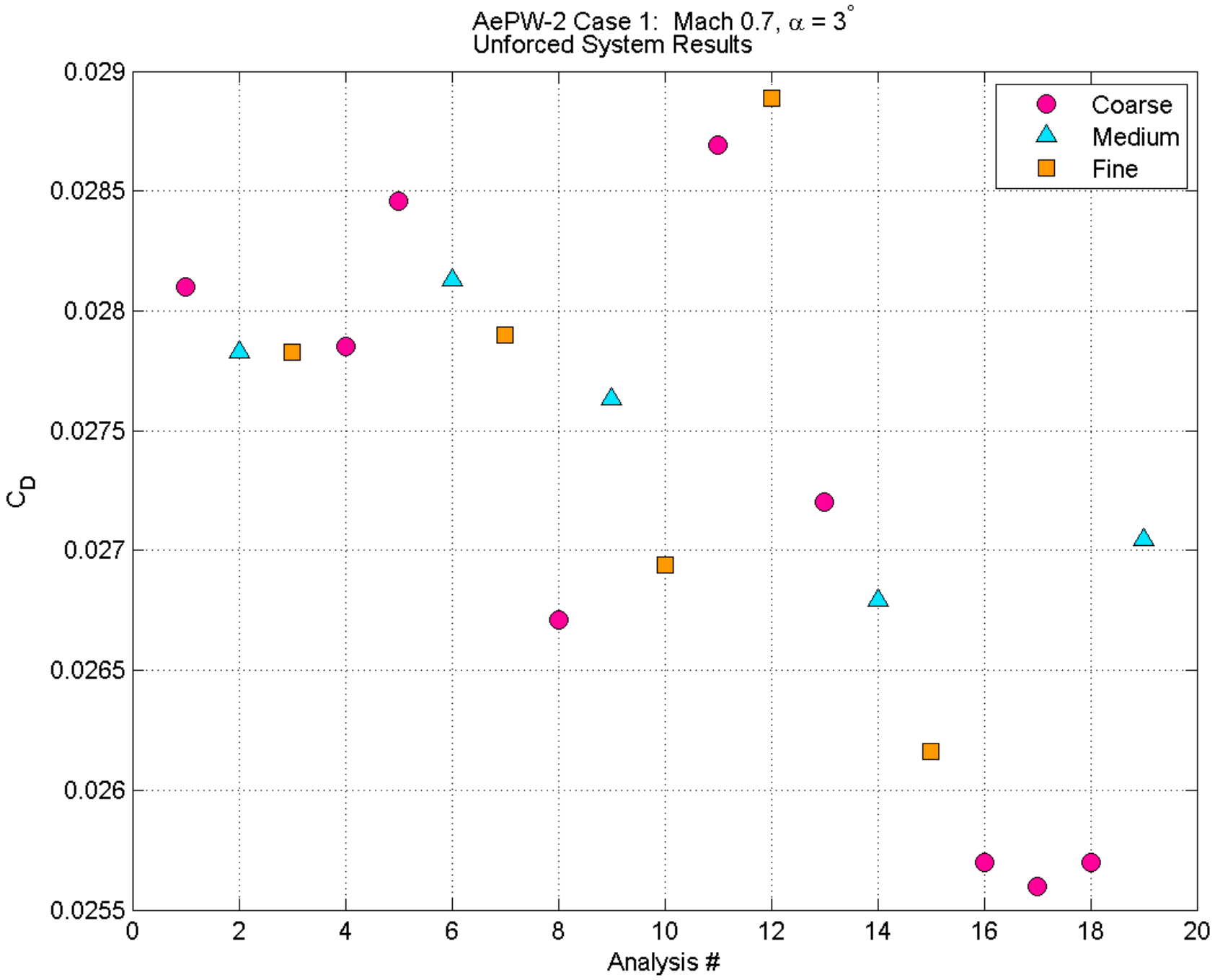
	Case 1	Case 2	Optional Case 3		
			A	B	C
Mach	0.70	0.74	0.85	0.85	0.85
Angle of attack	3°	0°	5°	5°	5°
Dynamic Data Type	Forced oscillation	Flutter	Unforced Unsteady	Forced Oscillation	Flutter
Notes:	• Attached flow solution. • Oscillating Turn Table (OTT) exp data.	• Unknown flow state. • Pitch and Plunge Apparatus (PAPA) exp data.	• Separated flow effects. • Oscillating Turn Table (OTT) experimental data.	• Separated flow effects. • Oscillating Turn Table (OTT) experimental data.	• Separated flow effects on aeroelastic solution. • No experimental data for comparison.

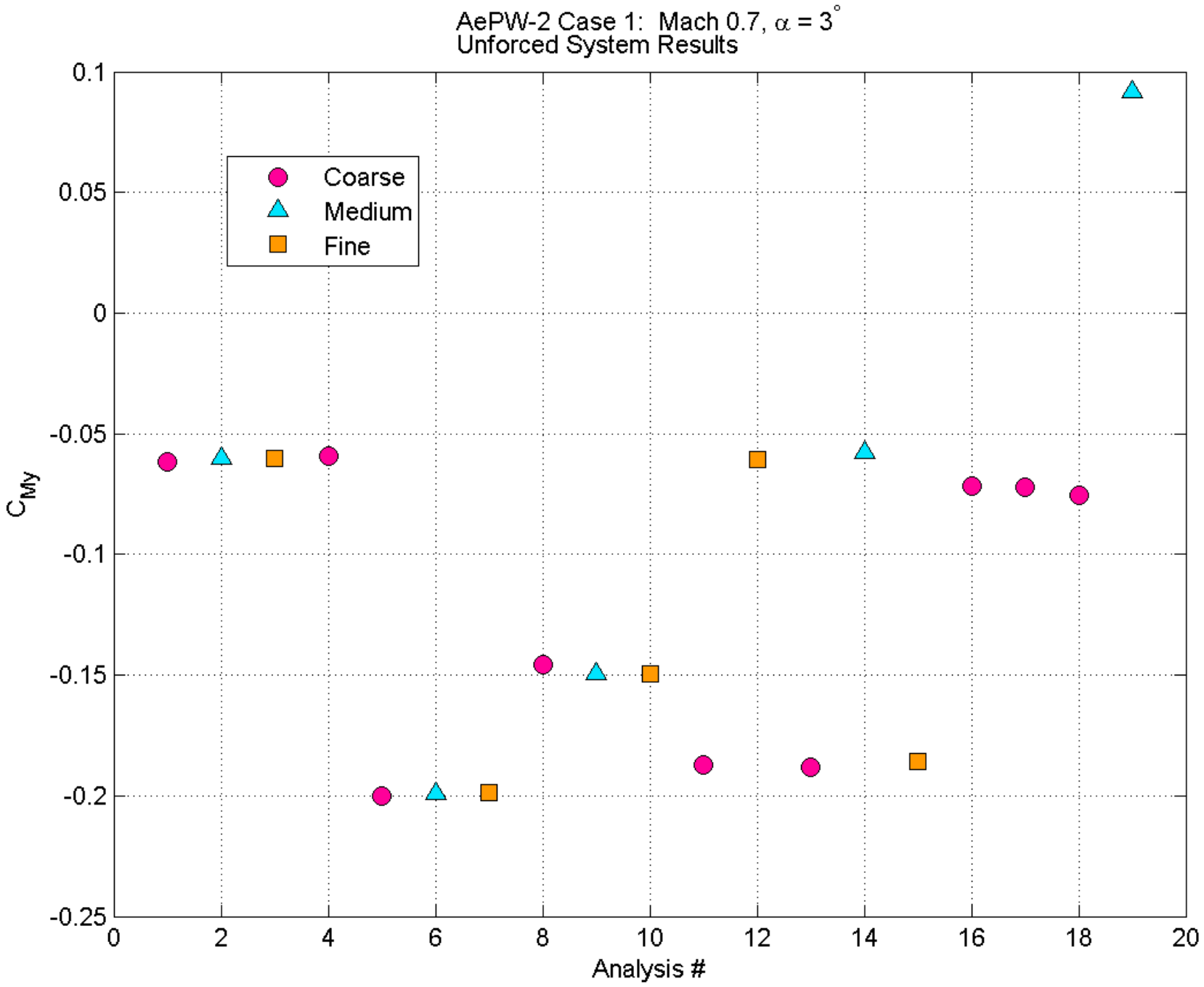
Progress Check: Aerodynamic Coefficients

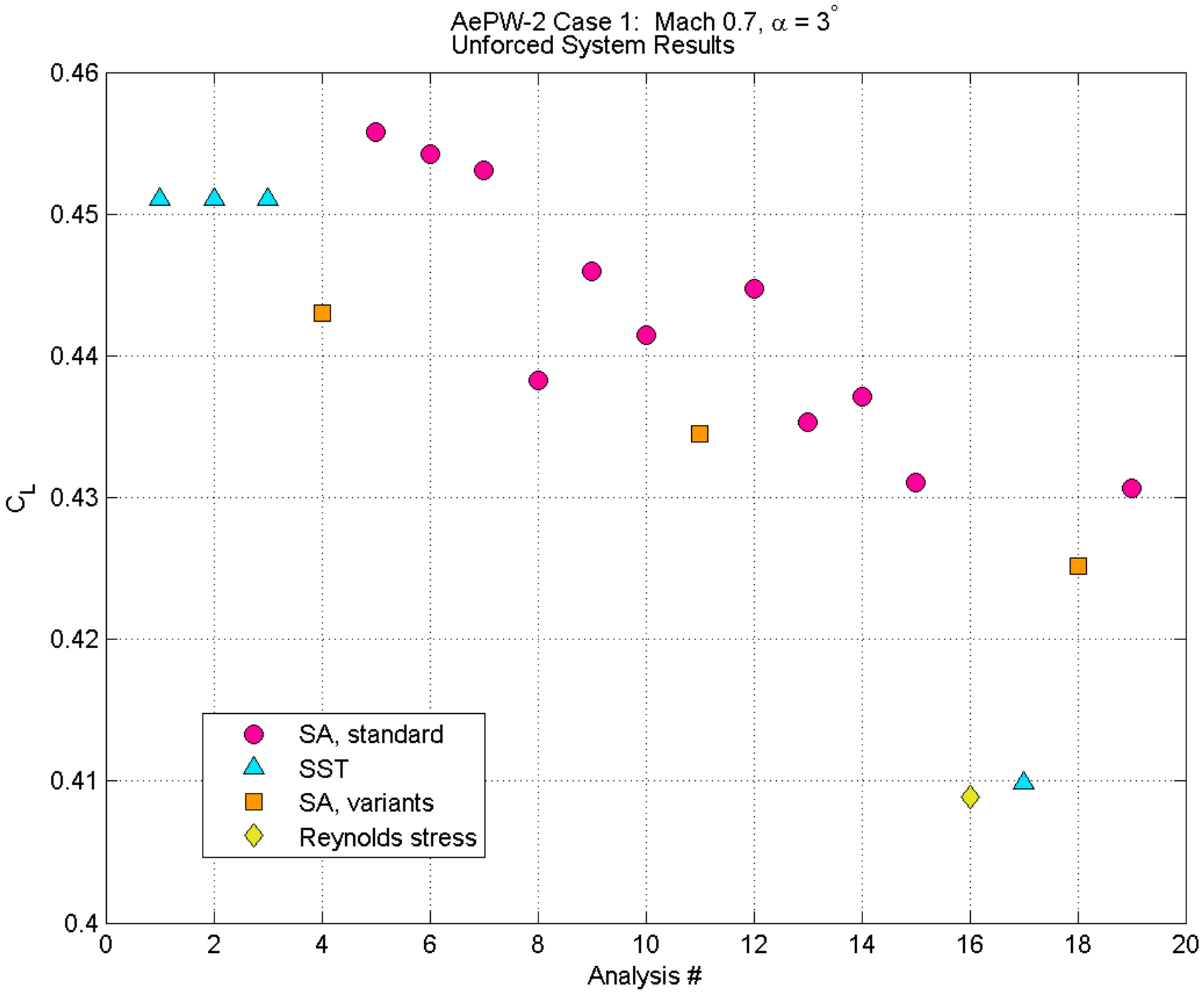
	CL	CD	CM_y	Mesh Resolution	Mesh (Provided / Own) and Type	Turbulence Model
1	0.45100	0.02810	-0.06160	Coarse	Provided / Unstructured	komega-SST
2	0.45100	0.02783	-0.06020	Medium	Provided / Unstructured	komega-SST
3	0.45100	0.02783	-0.06020	Fine	Provided / Unstructured	komega-SST
4	0.44300	0.02785	-0.05940	Coarse	Provided / Unstructured	Spalart-Allmaras One-Equation Model with fv3 Term (SA-fv3)
5	0.45579	0.02846	-0.20021	Coarse	Own / Structured	Standard Spalart-Allmaras One-Equation Model
6	0.45427	0.02813	-0.19926	Medium	Own / Structured	Standard Spalart-Allmaras One-Equation Model
7	0.45310	0.02790	-0.19856	Fine	Own / Structured	Standard Spalart-Allmaras One-Equation Model
8	0.43830	0.02671	-0.14553	Coarse	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
9	0.44598	0.02763	-0.14939	Medium	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
10	0.44143	0.02694	-0.14939	Fine	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
11	0.43454	0.02869	-0.18736	Coarse	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model WITH the ft2 term
12	0.44473	0.02889	-0.06080	Fine	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
13	0.43536	0.02720	-0.18823	Coarse	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
14	0.43711	0.02679	-0.05795	Medium	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
15	0.43108	0.02616	-0.18567	Fine	Provided / Unstructured	Standard Spalart-Allmaras One-Equation Model
16	0.40890	0.02570	-0.07180	Coarse	Own / Structured	Reynolds Stress
17	0.40990	0.02560	-0.07190	Coarse	Own / Structured	SST
18	0.42520	0.02570	-0.07560	Coarse	Own / Structured	Spalart-Allmaras One-Equation Model with Edwards Modification (SA-Edwards)
19	0.43068	0.02704	0.09171	Medium	Own / Unstructured	Standard Spalart-Allmaras One-Equation Model

Pitching moment coefficient reference point is at 30% chord or 4.8 inches from the leading edge!


AePW-2 Case 1: Mach 0.7, α = 3°
Unforced System Results
Coarse
Medium
Fine
C_L
Analysis #
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0
2
4
6
8
10
12
14
16
18
20


AePW-2 Case 1: Mach 0.7, α = 3°
Unforced System Results
Coarse
Medium
Fine
C_D
Analysis #
0.029
0.0285
0.028
0.0275
0.027
0.0265
0.026
0.0255
0
2
4
6
8
10
12
14
16
18
20


AePW-2 Case 1: Mach 0.7, α = 3°
Unforced System Results
Coarse
Medium
Fine
C_{My}
Analysis #
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
0
2
4
6
8
10
12
14
16
18
20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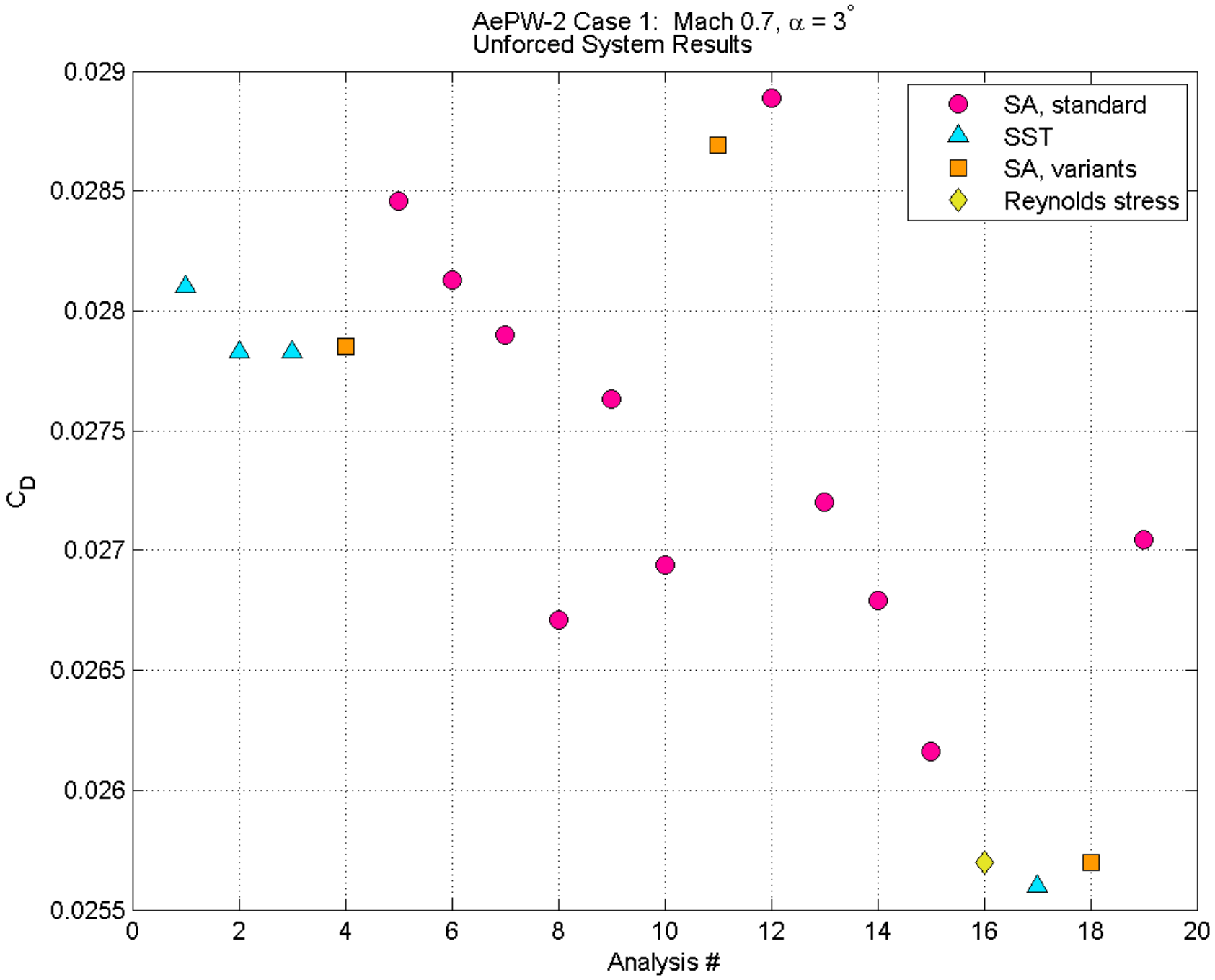
Unforced System Results
0.46
0.45
0.44
0.43
0.42
0.41
0.4
C_L
0
2
4
6
8
10
12
14
16
18
20
Analysis #
SA, standard
SST
SA, variants
Reynolds stress


AePW-2 Case 1: Mach 0.7, α = 3°
Unforced System Results
SA, standard
SST
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Analysis #
0.029
0.0285
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0.0255
0
2
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18
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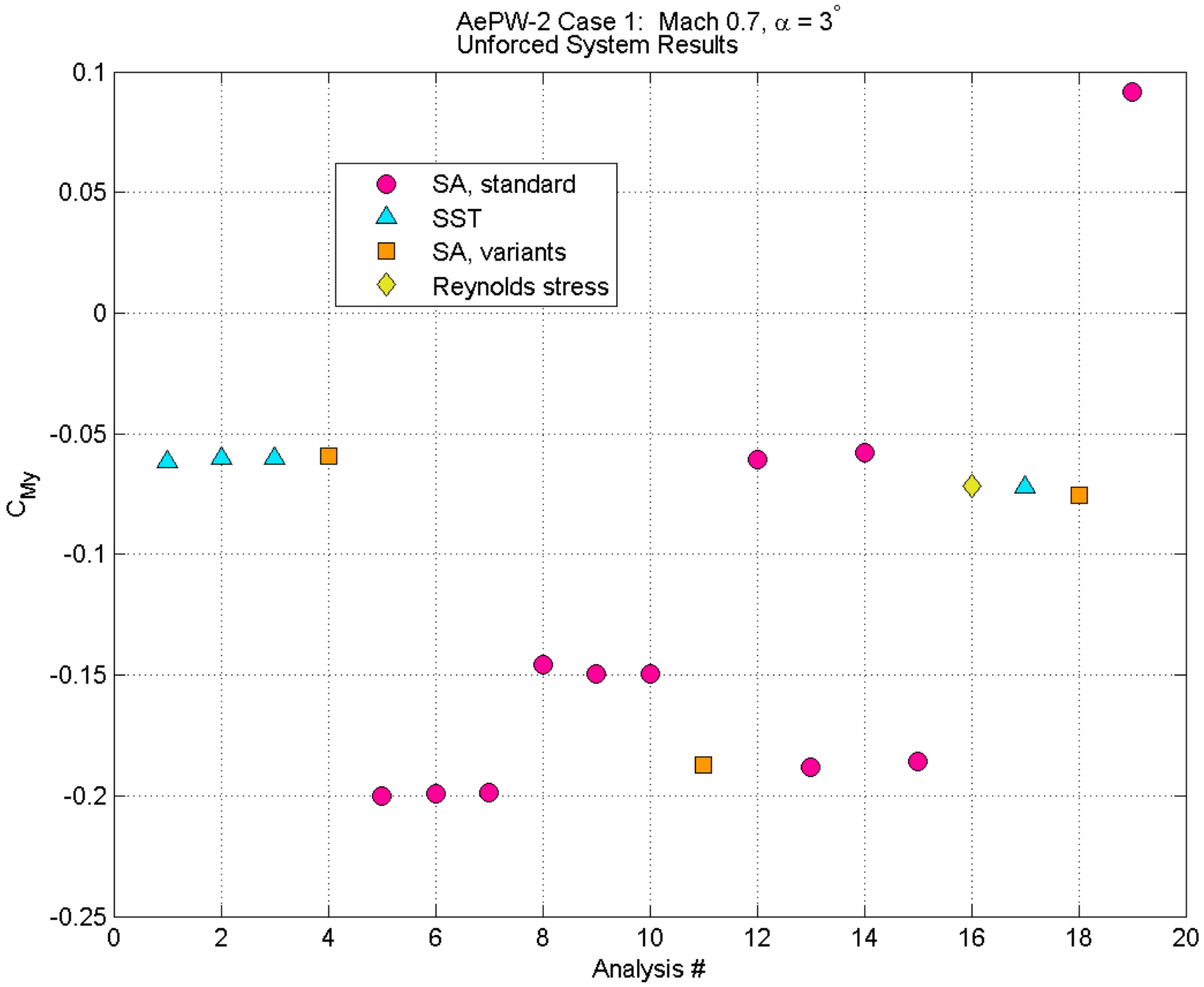
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C_My
Analysis #
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0.05
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-0.05
-0.1
-0.15
-0.2
-0.25
0
2
4
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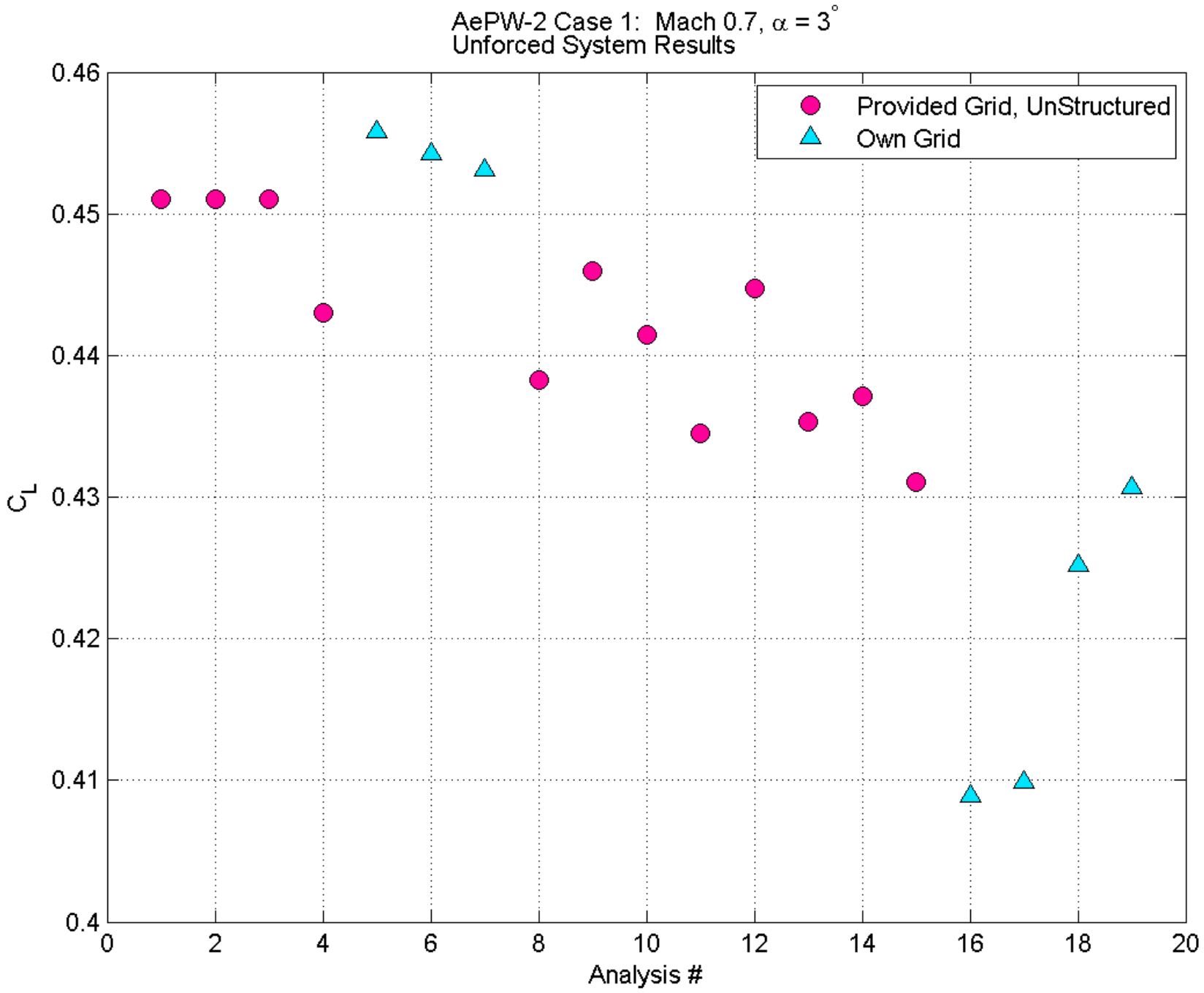
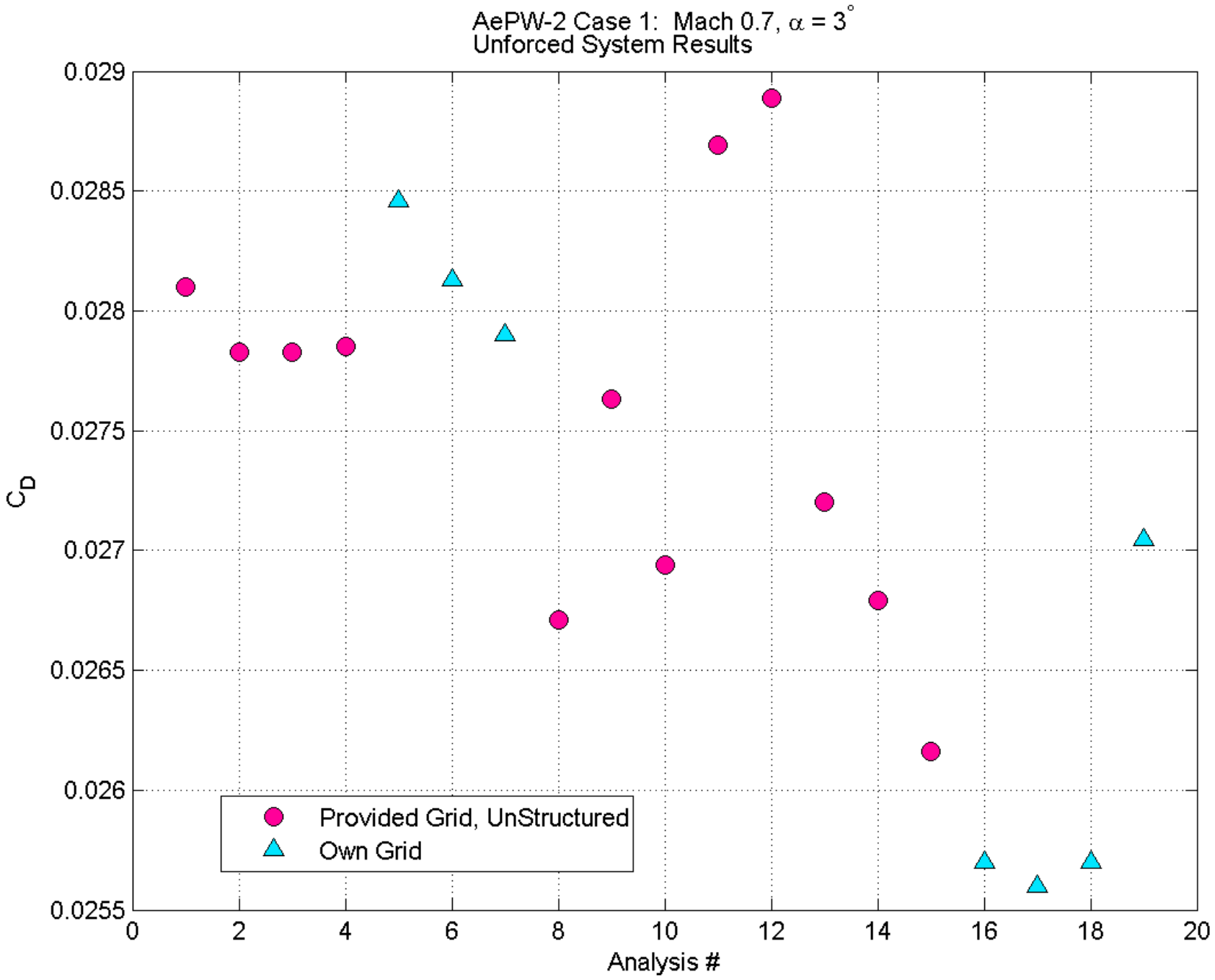
12
14
16
18
20


AePW-2 Case 1: Mach 0.7, α = 3°
Unforced System Results
Provided Grid, UnStructured
Own Grid
C_L
Analysis #
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0
2
4
6
8
10
12
14
16
18
20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0.0275
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0.0265
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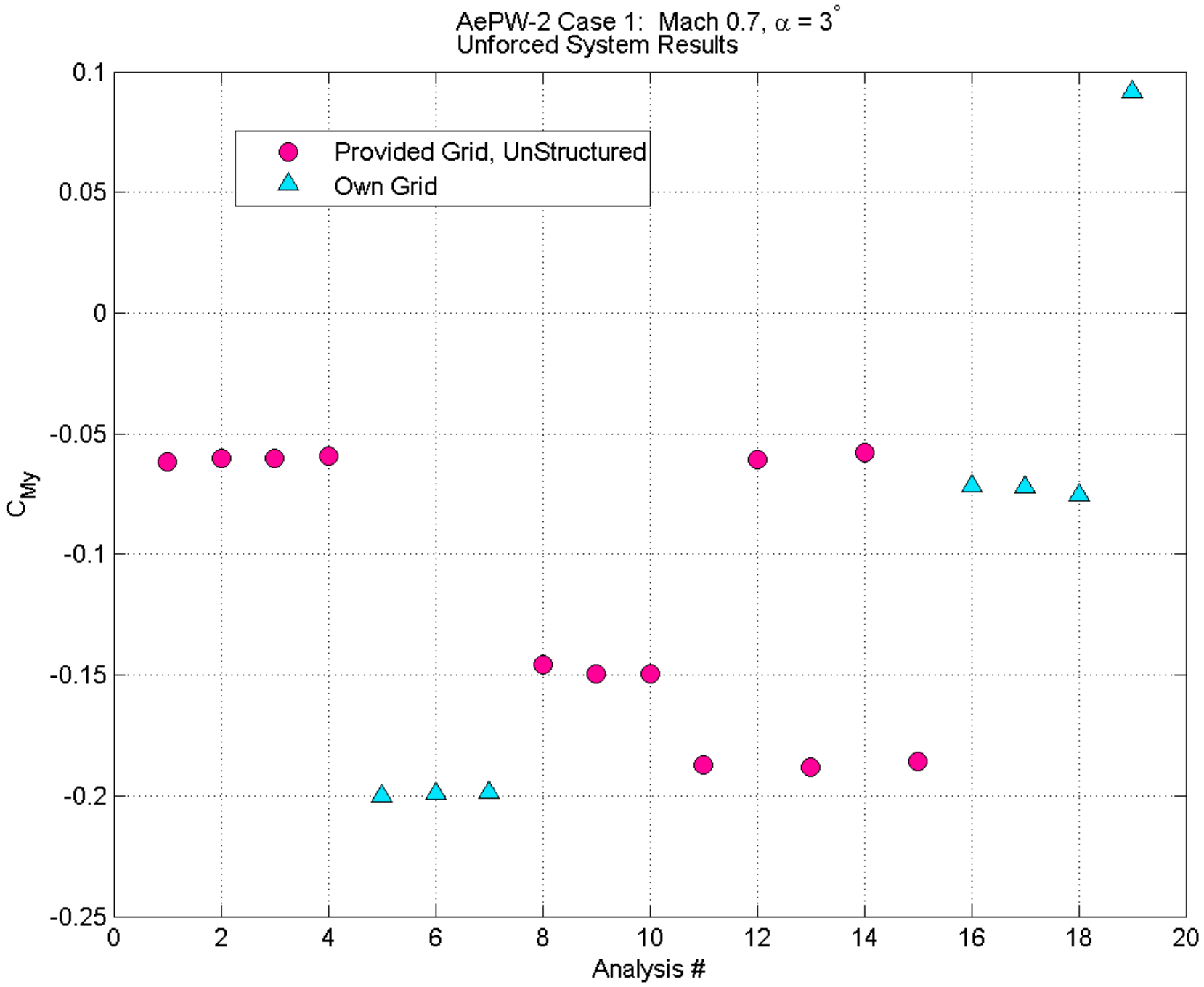
0.0255
C_D
0
2
4
6
8
10
12
14
16
18
20
Analysis #
Provided Grid, UnStructured
Own Grid


AePW-2 Case 1: Mach 0.7, α = 3°
Unforced System Results
Provided Grid, UnStructured
Own Grid
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
C_My
0
2
4
6
8
10
12
14
16
18
20
Analysis #

Updated analysis parameter table

Table 1. BSCW analysis input parameters forAePW-2, updated May 4, 2015.

Parameter	Symbol	Units	OTT Configuration	PAPA Configuration	OTT Configuration
Mach	M		0.7	0.74	0.85
AoA	α	deg	3°	0°	5°
Reynolds number (based on chord)	Re_c		4.560x10^6	4.450x10^6	4.491x10^6
Reynolds number per unit length	Re	Re_c/ft	3.456x10^6	3.338x10^6	3.368x10^6
Dynamic pressure	q	psf	170.965	168.800	204.197
Velocity	V	ft/s	387.332	375.700	468.983
Speed of sound	a	ft/s	553.332	506.330	552.933
Static temperature	T_{stat}	F	85.692	89.250	87.913
Density	ρ	$slug/ft^3$	0.00228	0.002392	0.001857
Ratio of specific heats	γ		1.113	1.136	1.116
Dynamic viscosity	μ	$slug/ft-s$	2.58x10^{-7}	2.69x10^{-7}	2.59x10^{-7}
Prandtl number	Pr		0.683	0.755	0.674
Test medium			R-134a	R-12	R-134a
Total pressure	H	psf	823.17		757.31
Static pressure	p	psf	629.661		512.120
Purity	X	%	95	95	95
Ref. molecular weight based on 100% purity	M	g/mol	102.03	120.91	102.03
Sutherland's constant	C	R	438.07	452.13	438.07
Reference viscosity	μ_{ref}	$lb-sec/ft^2$	2.332x10^{-7}	2.330x10^{-7}	2.332x10^{-7}
Reference temperature	T_{ref}	R	491.4	491.4	491.4

Geometric reference parameters

Description	Symbol	Value
Reference chord	c_{ref}	16 *inches*
Model span	b	32 *inches*
Area	A	512 $inch^2$
Moment reference point relative to axis system def.	x y z	4.8 *inches*, 30% 0.0 *inches* 0.0 *inches*
Frequency Response Function reference quantity	FRF	Pitch angle

Differences between tests and configurations

Test number	470	548
Mount system	PAPA	OTT
Pitch axis, % chord	50%	30%
Test medium	R-12	R-134a
Pressure transducer spanwise locations	60%, 90%	60%
Steady data configuration	Rigidized mount system	Unforced system
Forced oscillation data?	No	Yes
Flutter data?	Yes	No
Time history records?	No	Yes

Sept 8, 2015 note: The outboard pressure transducer location is at the 95% span station, not the 90% span station as shown in the table and given in the SciTech 2015 paper