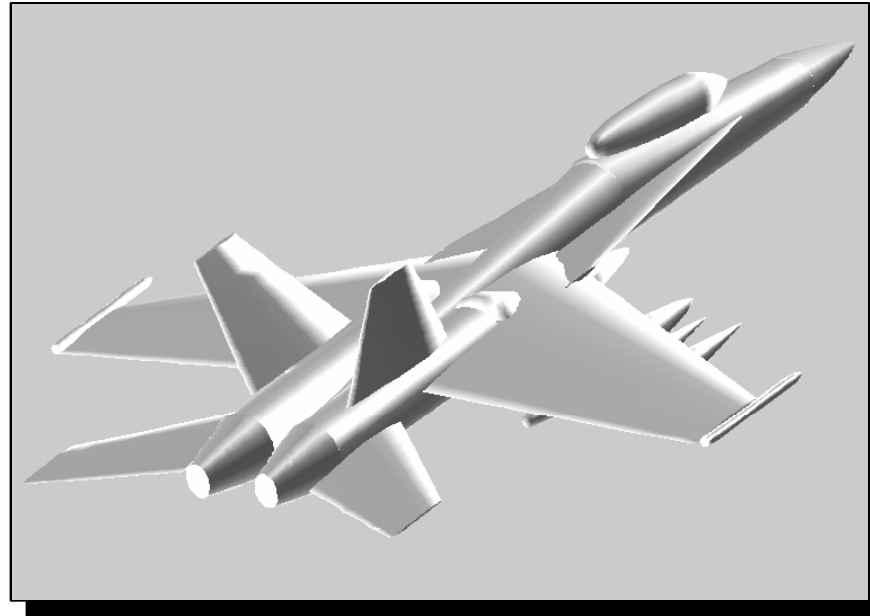


ACSYNT

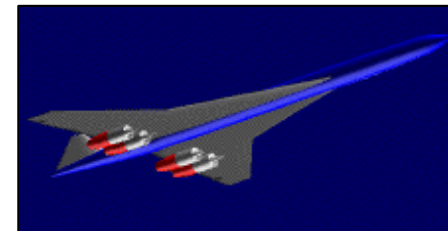
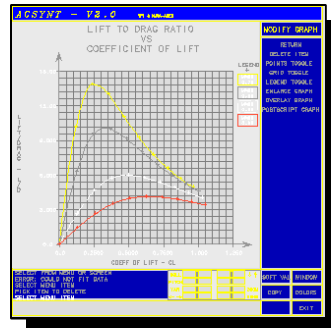
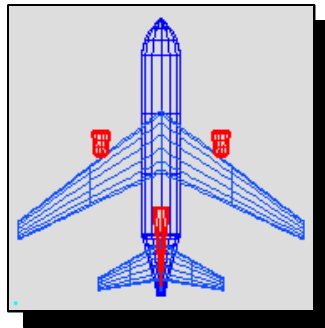


Program Overview/User Orientation



What is ACSYNT?

Parametric design tool for aircraft synthesis...



*Concept
Development*

*Preliminary
Design*

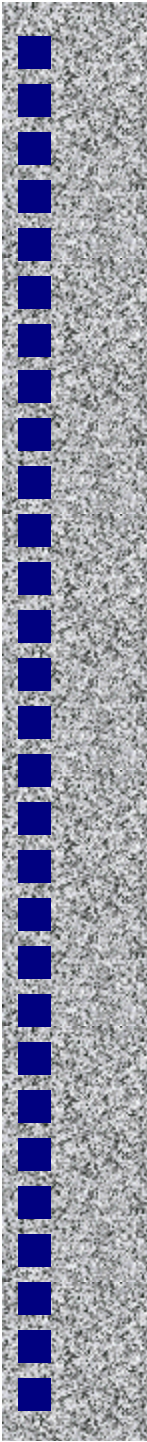
*Detailed
Design*

ACSYNT

- *Lots of Designs*
- *Tradeoff Studies*
- *"Requirements Optimization"*

- *In-depth analysis*
- *Narrowed to few designs*
- *Detailed optimization*

- *Detailed analysis*
- *Subsystem design & optimization*



ACSYNT Is...

Component-based CAD

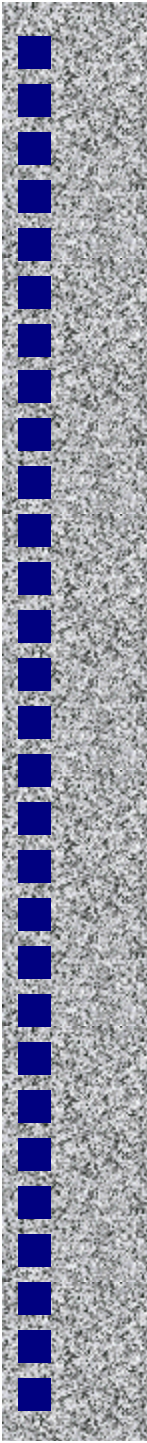
Conceptual level synthesis tool

Tool for tradeoff studies

Multidisciplinary

Capable of optimization

Only part of a complete design diet



ACSYNT Is Not...

CFD

FEM

Airfoil Design Tool

Primitive-Based CAD (i.e. AutoCAD)

Detailed Design

Animation Tool

Flight Simulator

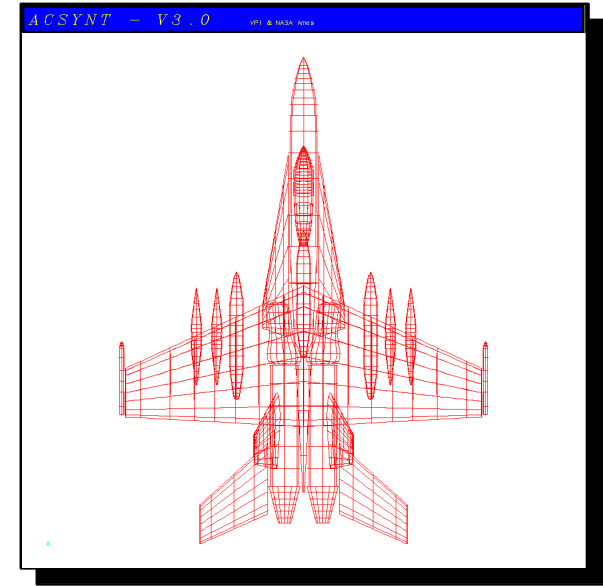
Learning Curve

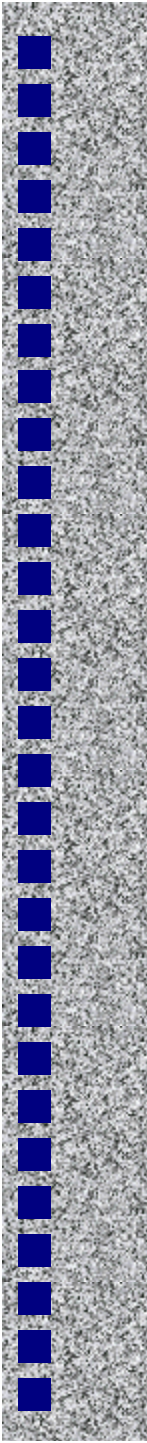
Steep

Recommendations:

- ◆ Read the user guide
- ◆ Look at examples (input/output)
- ◆ Experiment

Rewarding if mastered





Getting Started

Things You'll Need

Know your mission

Have a good three-view

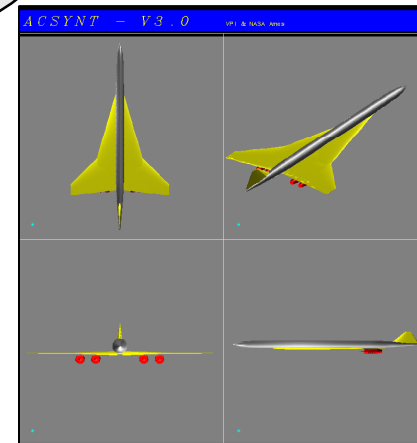
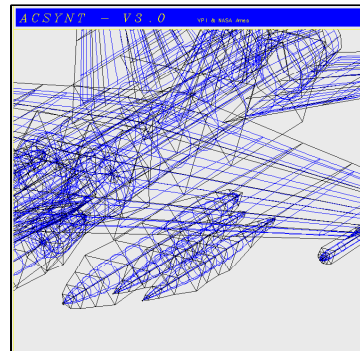
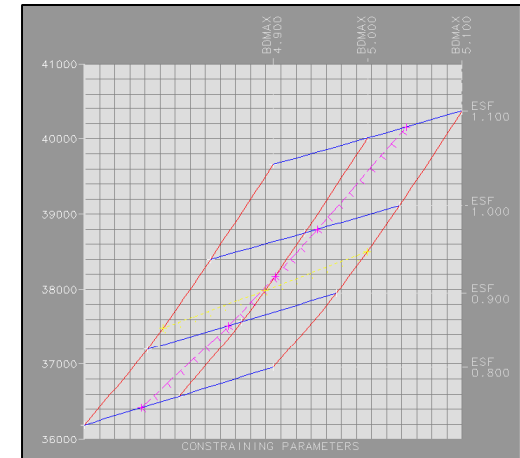
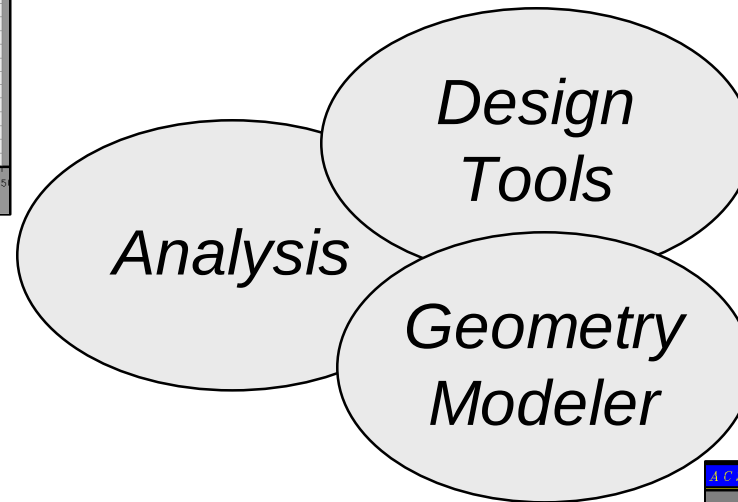
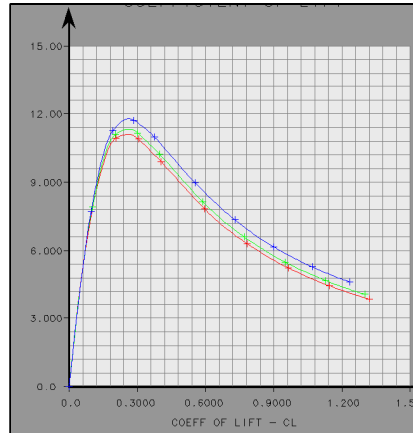
Collect as much info about engine

Payloads, fixed weights

Airfoil type

Ballpark estimate of weight

Program Kernals



ACSYNT
Program Overview/User Orientation

Starting ACSYNT

- 1) login with userid, password
- 2) type "cd acsynt"
- 3) type "acsynt"

MAIN MENU	
GEOMETRY	
TRAJECTORY	
AERODYNAMICS	
PROPULSION	
STABILITY	
WEIGHTS	
SUPERSONIC AERO	
ECONOMICS	
TAKEOFF	
COPIES INPUT	
ACSYNT CONTROL	
ANALYSIS	
FILE	
SOFT VAL	WINDOW
COPY	COLORS
	EXIT

File Selection Screen

1) From main menu select "FILE"

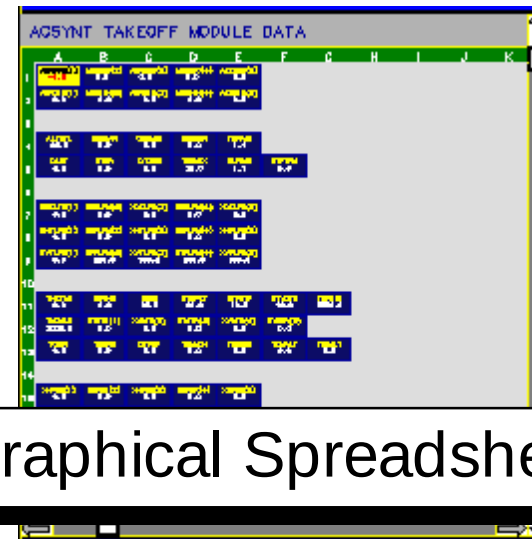
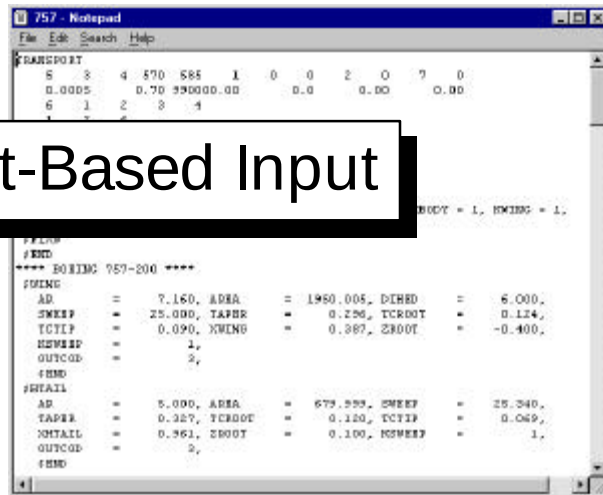
You should see
the following screen...

File Types

Geometry

Analysis

ACSYNT FILE LISTING		PAGE 1/1	NONE/NONE
SAMPLE FILES			
F15	MCDONNELL DOUGLAS F-15 GEOMETRY		GEOMETRY
F15IN	F-15 ANALYSIS INPUT FILE		GEOMETRY
FA18	MCDONNELL DOUGLAS F/A-18 GEOMETRY		ACSYNT INPUT
F4	MCDONNELL DOUGLAS F-15 GEOMETRY		GEOMETRY
AV8B	MCDONNELL DOUGLAS AV-8B HARRIER GEOMETRY		GEOMETRY
DC10	MCDONNELL DOUGLAS DC10 COMMERCIAL		GEOMETRY
DC10IN	DC10 ANALYSIS INPUT FILE		ACSYNT INPUT
C17	MCDONNELL DOUGLAS C17 TRANSPORT		GEOMETRY
C17IN	C17 ANALYSIS INPUT FILE		ACSYNT INPUT
BAE1000	BRITISH AEROSPACE 1000 REGIONAL JET		GEOMETRY
BAE1KIN	BAE1000 ANALYSIS INPUT FILE		ACSYNT INPUT
BJ400A	BEECHCRAFT 400 BUSINESS JET		GEOMETRY
BJ400IN	BJ400A ANALYSIS INPUT FILE		ACSYNT INPUT
B2	NORTHROP-GRUMMAN B2 GEOMETRY		GEOMETRY
A6	GRUMMAN INTRUDER GEOMETRY		GEOMETRY
F16	F-16 GEOMETRY		GEOMETRY
F16IN	INPUT FILE FOR F-16A		ACSYNT INPUT
F2BASE	BASE INPUT FILE FOR 2 ENGINE FIGHTERS		ACSYNT INPUT
F2IN	TWIN ENGINE FIGHTER INPUT FILE		ACSYNT INPUT
JUNK	NO DESCRIPTION		ACSYNT INPUT



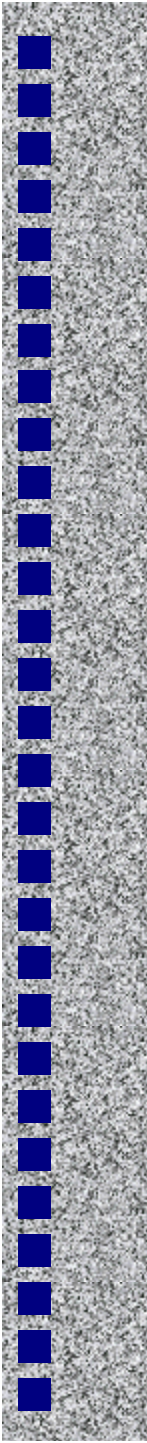
Graphical Spreadsheet

Geometry Overview

3D Bspline surfacing
Modeller allows

- ◆ Airfoil types
- ◆ Body components
- ◆ Pods
- ◆ Gen pods
- ◆ Cross section buildup





Building Geometry (Intro)

Think in cross sections

ACSynt Cannot directly analyze:

- ◆ Joined Wings
- ◆ Box Wings
- ◆ Biplanes

Tips

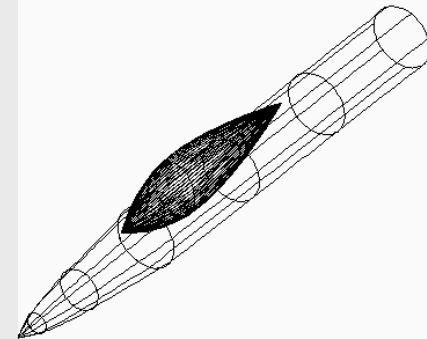
- ◆ Start with basic components first
- ◆ You can model more than you can analyze

Building Geometry (1)

Add Component

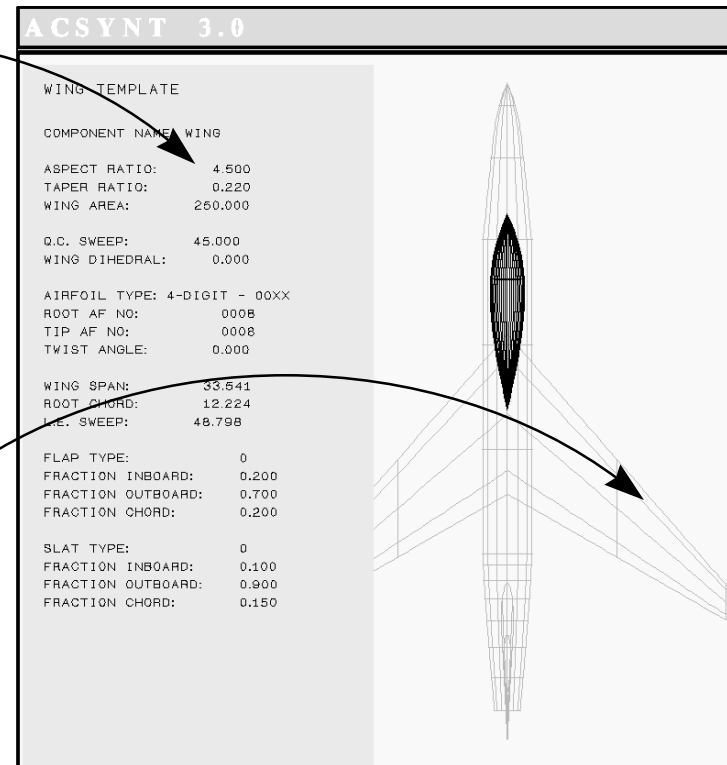
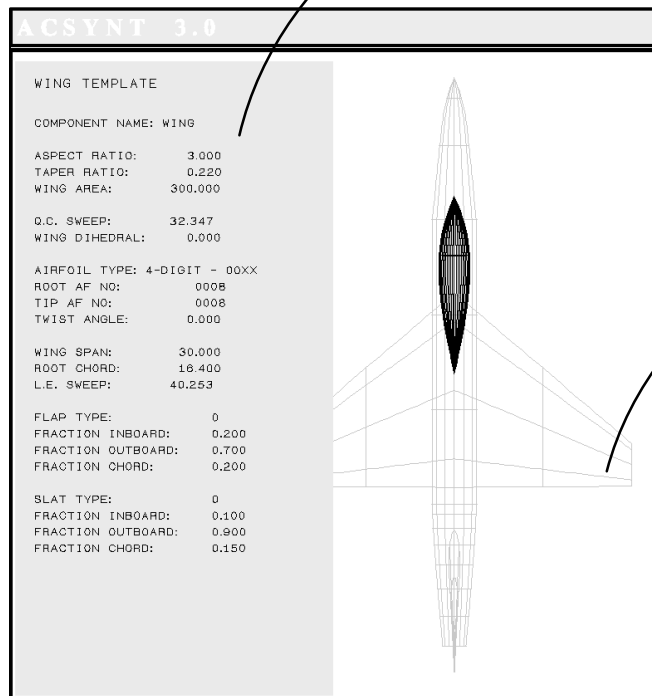
COMPONENT LIST PAGE 1

3	AFT_BODY	->	NO PARENT
4	WING	->	NO PARENT
5	HORZ_TAIL	->	NO PARENT
6	VERT_TAIL	->	NO PARENT
7	CANARD	->	NO PARENT
8	STRAKE	->	NO PARENT
9	FUS STORE	->	NO PARENT
10	WING STORE	->	NO PARENT
12	SUP. PIT.	->	NO PARENT
13	SUP. CON.	->	NO PARENT
14	SUP. 2D IN	->	NO PARENT
15	INL. AFT B	->	SUP. CON.
16	FUS ENG	->	NO PARENT
17	WING ENG	->	NO PARENT
18	MS_WING	->	NO PARENT
19	GEN_POD	->	NO PARENT
20	SEAT	->	NO PARENT
21	BOX	->	NO PARENT
22	CS_OBJECT	->	NO PARENT



Building Geometry (2)

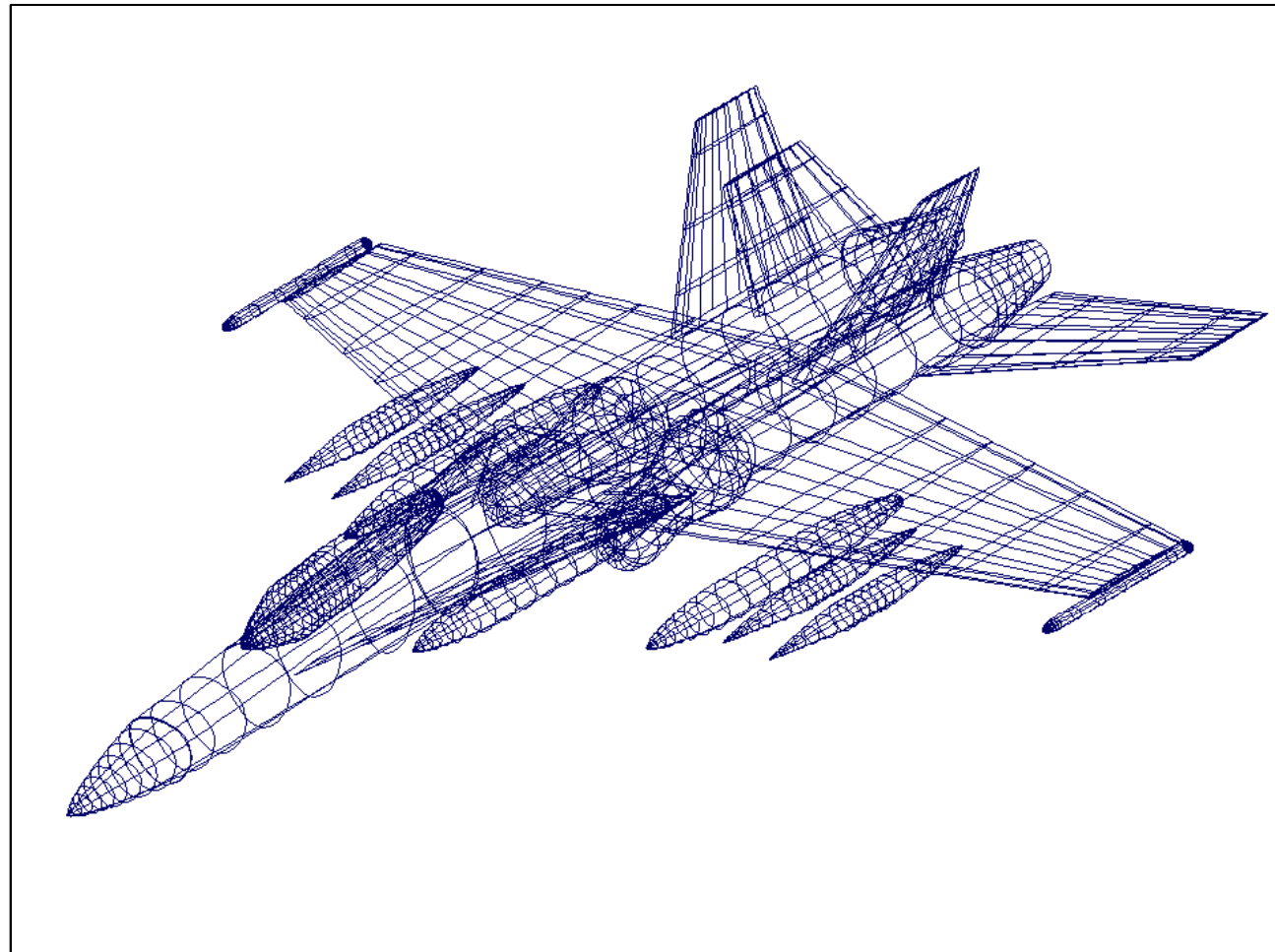
Modify Component



Graphic file support

CAD: IGES Export

Graphics (XV): GIF, JPEG, TIFF, BMP



Laying out a Mission

Phase-based mission

Point performance

BCA/BCM

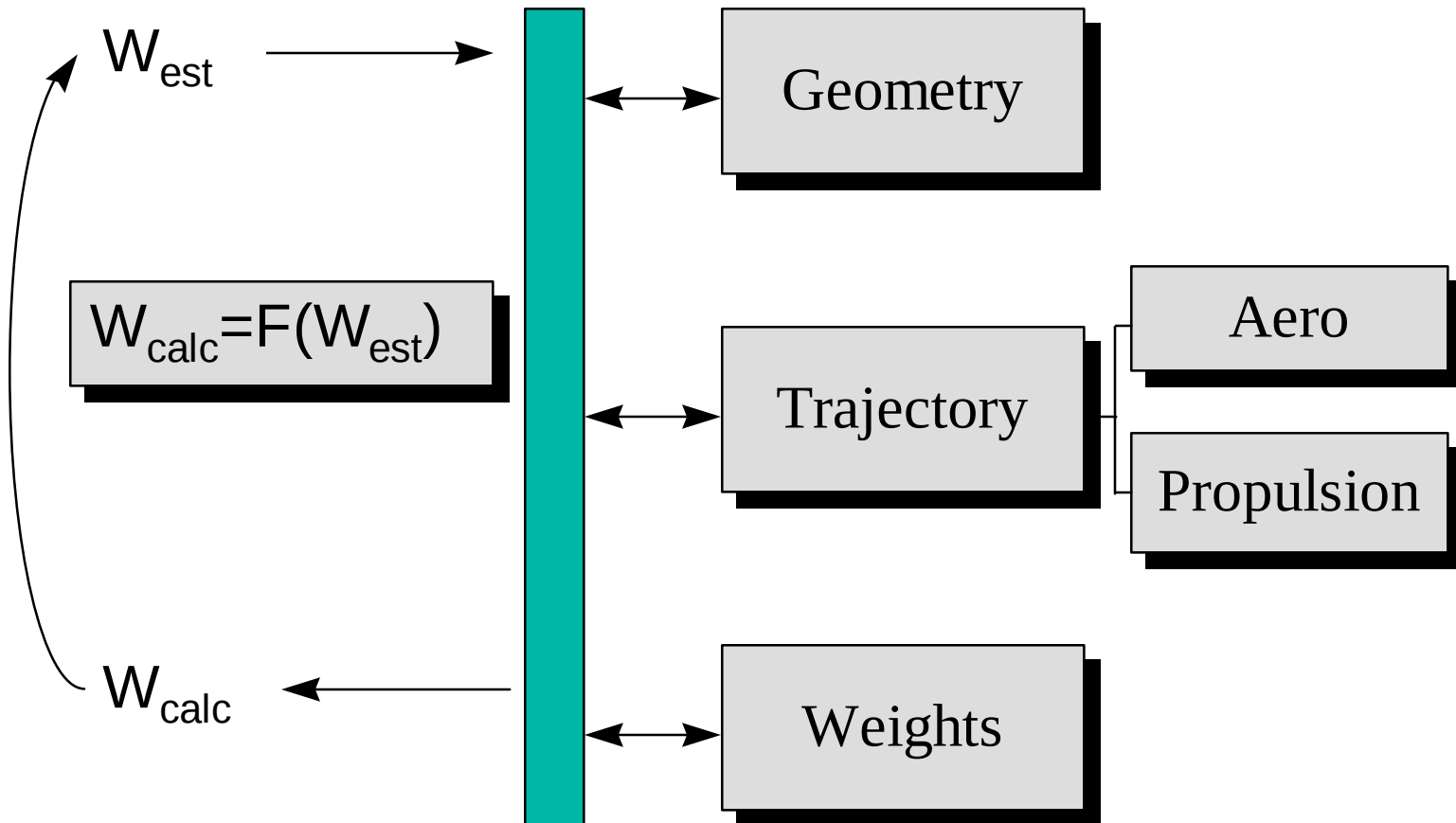
Max rate climbs

Weapons release

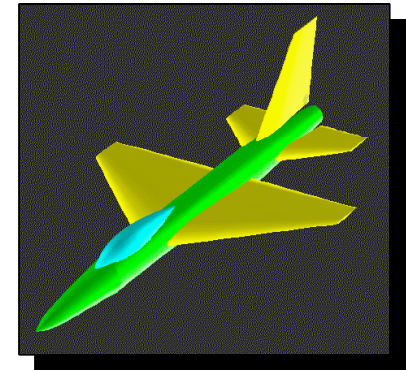
- Takeoff
- Climb
- Accel
- Cruise
- Combat
- Loiter
- Descent
- Hover

Convergence

Iterative Weight Sizing Process



Aerodynamics



Minimum Drag

Transonic (M_{DD})

Skin Friction

Wave Drag

Component buildup

Data correlation (Geom, α)

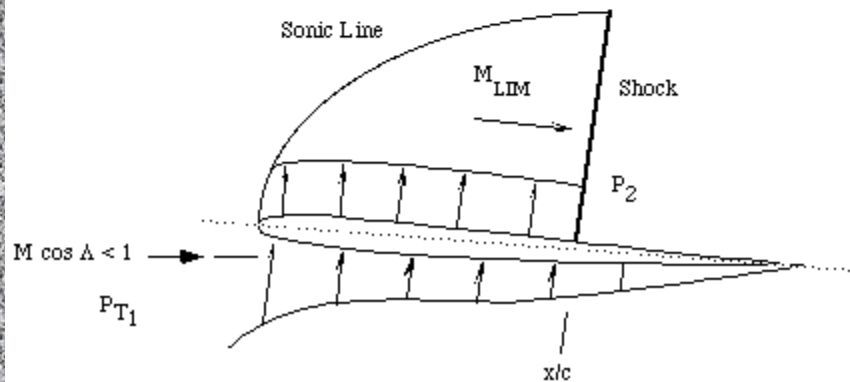
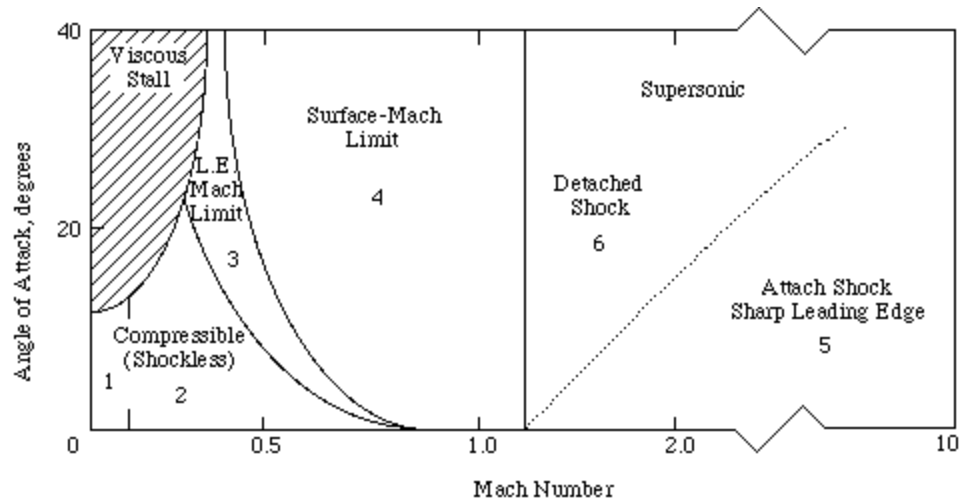
Sommer-Short (TR R-123, 1962)

Momentum theory / area rule est.
(Sears-Haack)

Induced Drag

AEROX - NASA TM X-73,208
Semi-empirical based on
compressible theory

Aerodynamic Zones



1. Incompressible
2. Shock Free
3. Leading-Edge Mach-Limited
4. Surface Mach-Limited
5. Supersonic Attached Shock
6. Supersonic Detached-Shock

Weights

Component-based
empirical methods

Generate standard
statements

Fixed vs. Computed

- ◆ $W = \text{Input Value}$: Fixed
- ◆ $W = F(\text{WGTO})$: Computed

Slopes, Tech Factors

- ◆ $W = \text{SLOPE}(I) * W$
- ◆ $W = \text{TECH}(I) * W$

Component	Pounds	Kilograms	Percent	Slope	Tech	Fixed
Airframe Structure	72556.	32911.	29.12			No
Wing	24419.	11076.	9.80	1.00	1.00	No
Fuselage	27608.	12523.	11.08	1.00	1.00	No
Horizontal Tail (Low)	4593.	2083.	1.84	1.00	1.00	No
Vertical Tail	2212.	1003.	.89	1.00	1.00	No
Nacelles	3979.	1805.	1.60	1.00	1.00	No
Landing Gear	9745.	4421.	3.91	1.00	1.00	No
Propulsion	21742.	9862.	8.73			No
Engines (2)	20070.	9104.	8.05	1.00	1.00	No
Fuel System	1672.	759.	.67	1.00	1.00	No
Fixed Equipment	33909.	15381.	13.61		1.00	No
Hyd & Pneumatic	1495.	678.	.60	1.00		No
Electrical	2852.	1294.	1.14	1.00		No
Avionics	1593.	723.	.64	1.00		No
Instrumentation	869.	394.	.35	1.00		No
De-ice & Air Cond	3721.	1688.	1.49	1.00		No
Aux Power System	631.	286.	.25	1.00		No
Furnish & Eqpt	19388.	8794.	7.78	1.00		No
Seats and Lavatories	10516.	4770.	4.22	1.00		No
Galley	3346.	1518.	1.34	1.00		No
Misc Cockpit	234.	106.	.09	1.00		No
Cabin Finishing	3639.	1651.	1.46	1.00		No
Cabin Emergency Equip	1291.	585.	.52	1.00		No
Cargo Handling	362.	164.	.15	1.00		No
Flight Controls	3360.	1524.	1.35	1.00		No
Empty Weight	128207.	58155.	51.46			
Operating Items	10609.	4812.	4.26			No
Flight Crew (2)	340.	154.	.14			No
Crew Baggage and Provisions	300.	136.	.12			No
Flight Attendants (6)	780.	354.	.31			No
Unusable Fuel and Oil	600.	272.	.24			No
Passenger Service	8589.	3896.	3.45			No
Cargo Containers	0.	0.	.00			No
Operating Weight Empty	138816.	62967.	55.71			
Fuel	62544.	28370.	25.10			
Payload	47800.	21682.	19.18			No
Passengers (239)	40630.	18430.	16.31			No
Baggage	7170.	3252.	2.88			No
Cargo	0.	0.	.00			No
Calculated Weight	249160.	113019.	100.00			No
Estimated Weight	249168.	113023.				

Propulsion

Cycle Analysis

- ◆ Installation Effects
- ◆ Scaling factors (T, SFC)
- ◆ Find a suitable compressor map/backbone

Input Deck

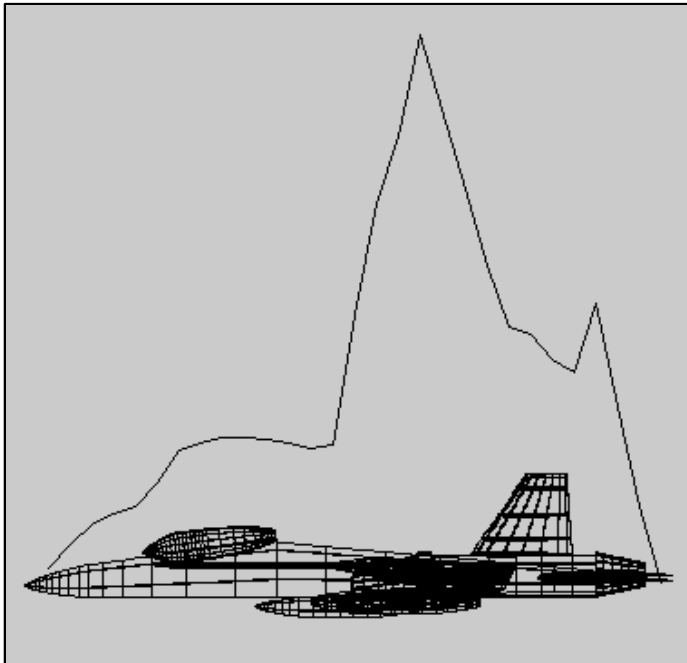
- ◆ More accurate
- ◆ More time consuming
- ◆ Less scalable

•J-85	(2.7/4k)
•TF-30	(14/25k)
•JT-8D	(14.5k)
•JT-9D	(50k)
•CF-6	(50k)

•M,h
•T
•SFC
•PWCC
•Throttle

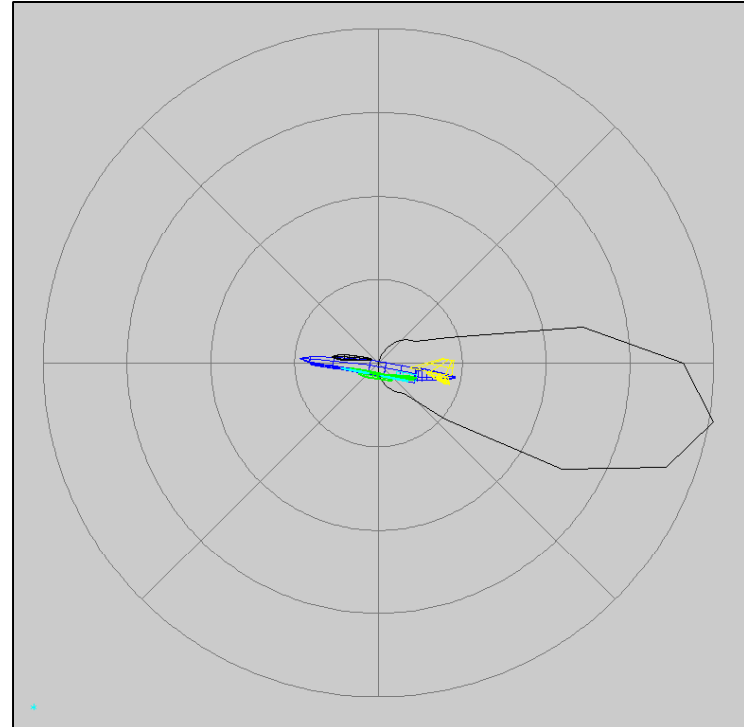
Design Tools

Area Plot



ACSYNT
Program Overview/User Orientation

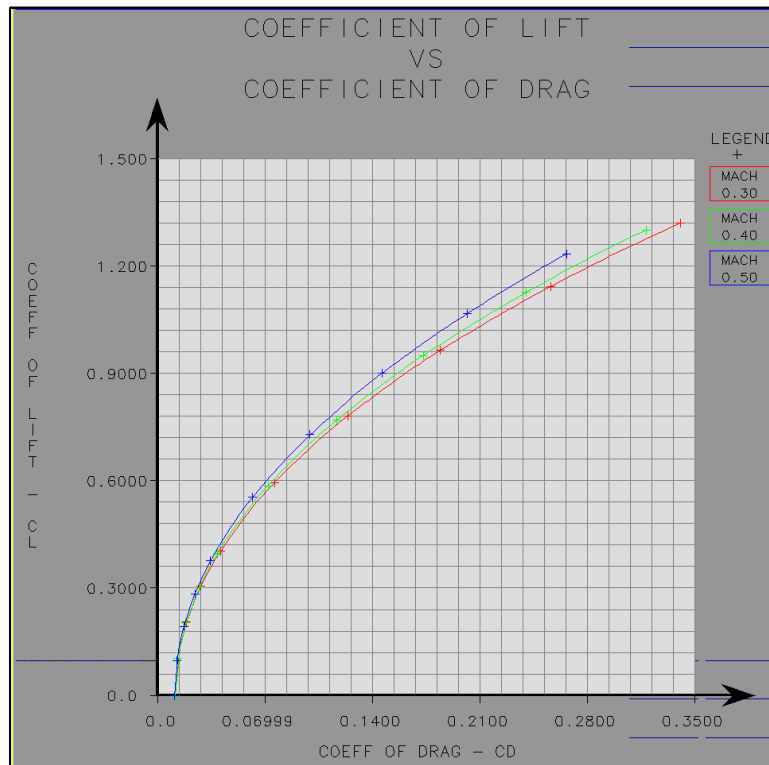
IR Analysis



Phoenix
INTEGRATION
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Design Tools

Aero Plots



ACSYNT
Program Overview/User Orientation

Carpet Plots

