Using PROPID for Analysis

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Steady-State Aerodynamics Codes for HAWTs
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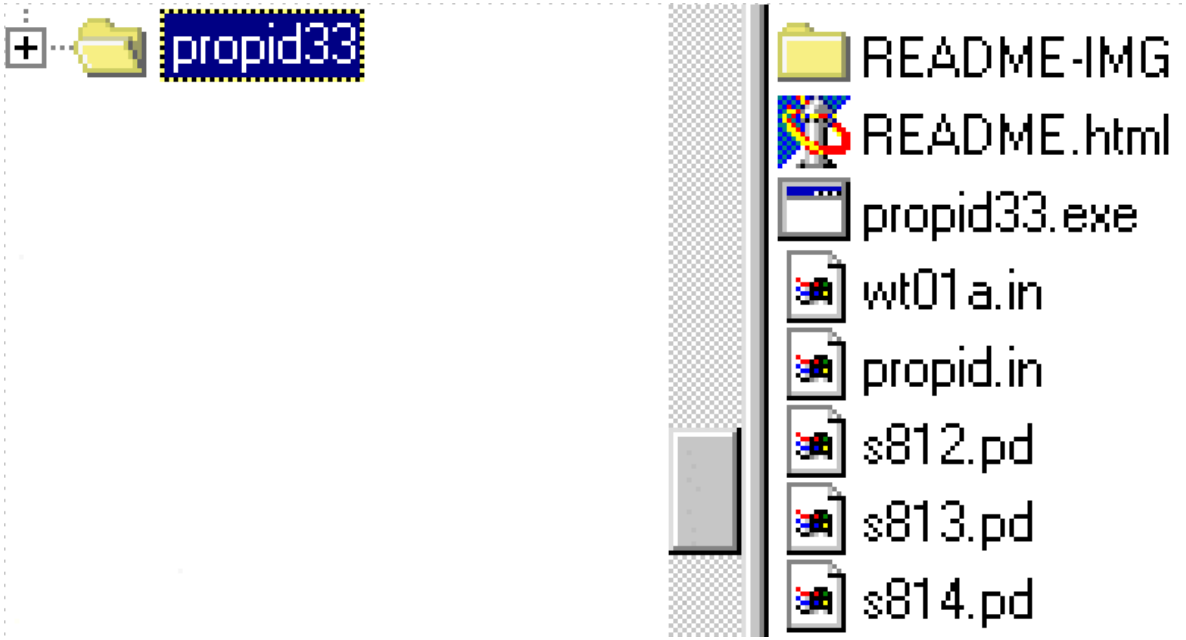
PROPID Code / Files Overview

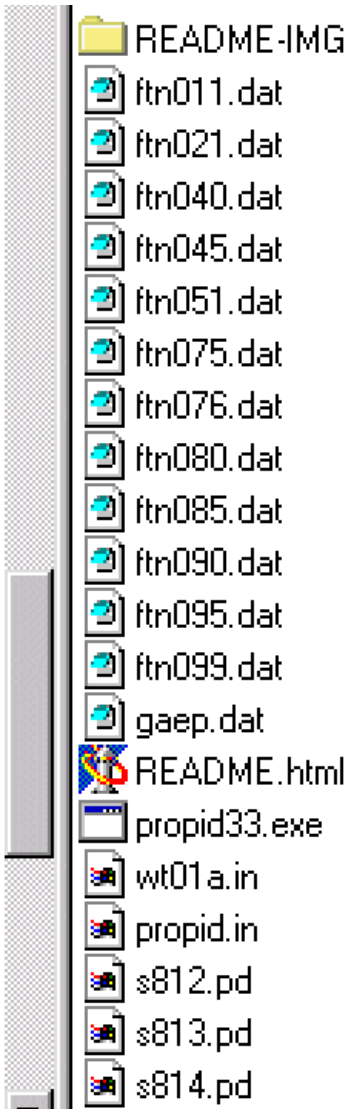
- PROPID Code:
  - Fortran77
  - 14,000 lines
- Files
  - propid53-32bit - DOS executable, latest version
  - propid.in - includes the input file name to run
  - wt01a.in - PROPID input file to run
  - s818.pd, etc - airfoil data files
  - ftn040.dat, etc - output files generated
- File Organization
  - Keep all files in the same directory (for simplicity)

Getting Started

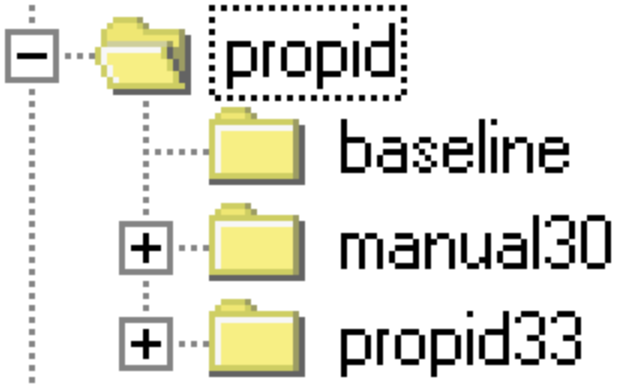
- Installation - PROPID
  - Copy the propid33.zip file (or latest version) to your PC and unzip to get:



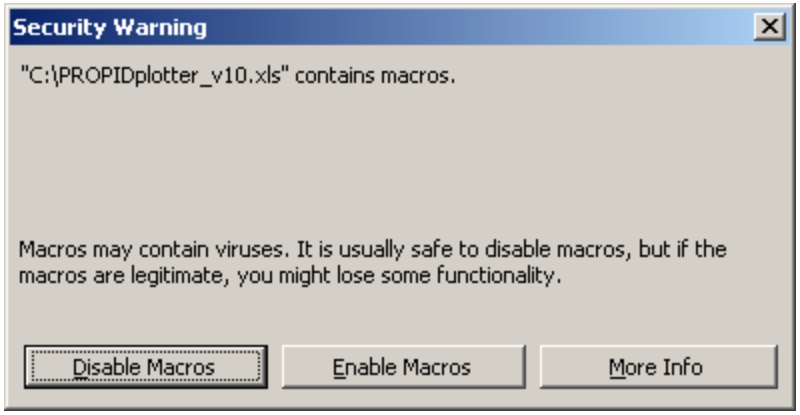
- To run, open a DOS window and type propid33.exe
  - Directory structure with output files



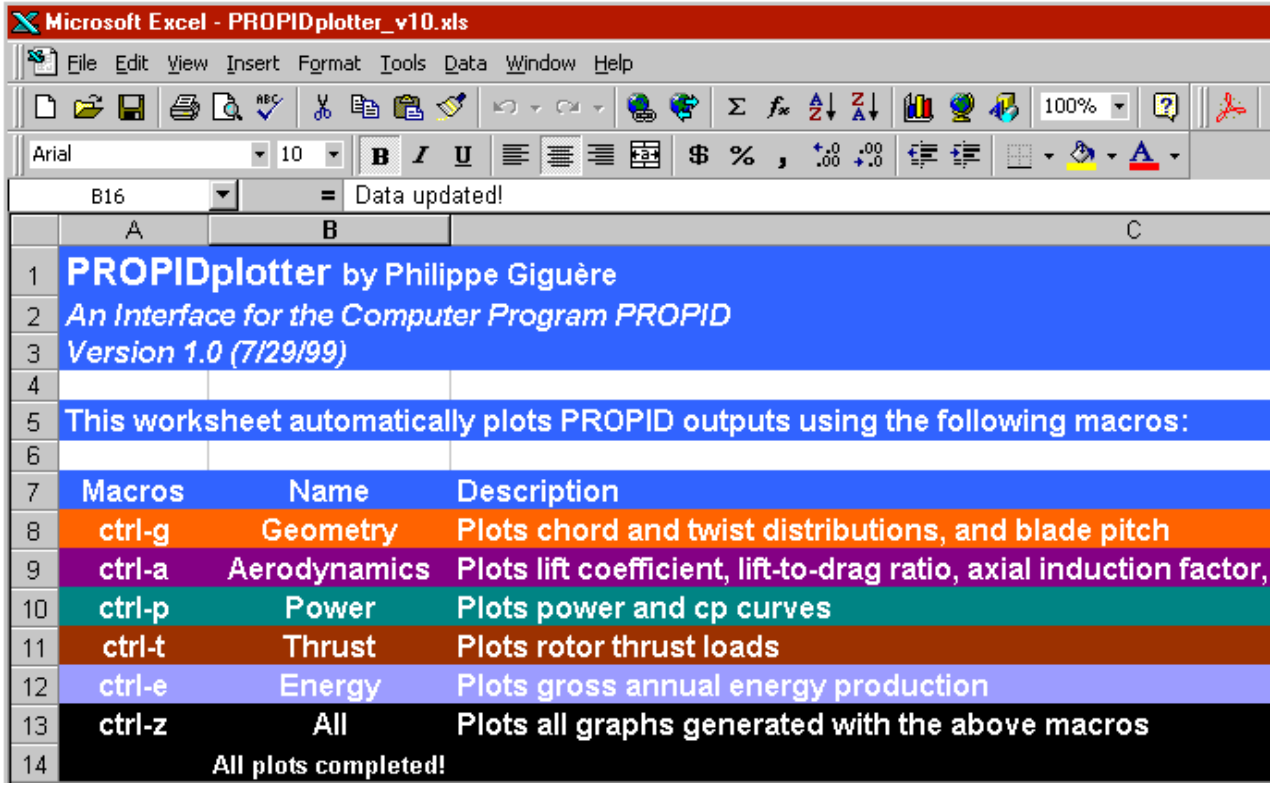
– Additional directories
  - baseline dir - files for comparison
  - manual30 - propid30 manual



- Installation - PROPIDplotter_v10.xls
  - Put PROPIDplotter_v10.xls in the “propid33” directory, which is ”“working” directory
  - Click on file. If prompted, click on “Enable Macros” (see below). Macros will be enabled only during the current session on the current file.



- PROPID Run: wt01a.in
  - ✓ Edit propid.in to include the filename wt01a.in
  - – Type propid33.exe to run (or latest version)
  - – Plot the data using PROPIDplotter (ctrl-z)

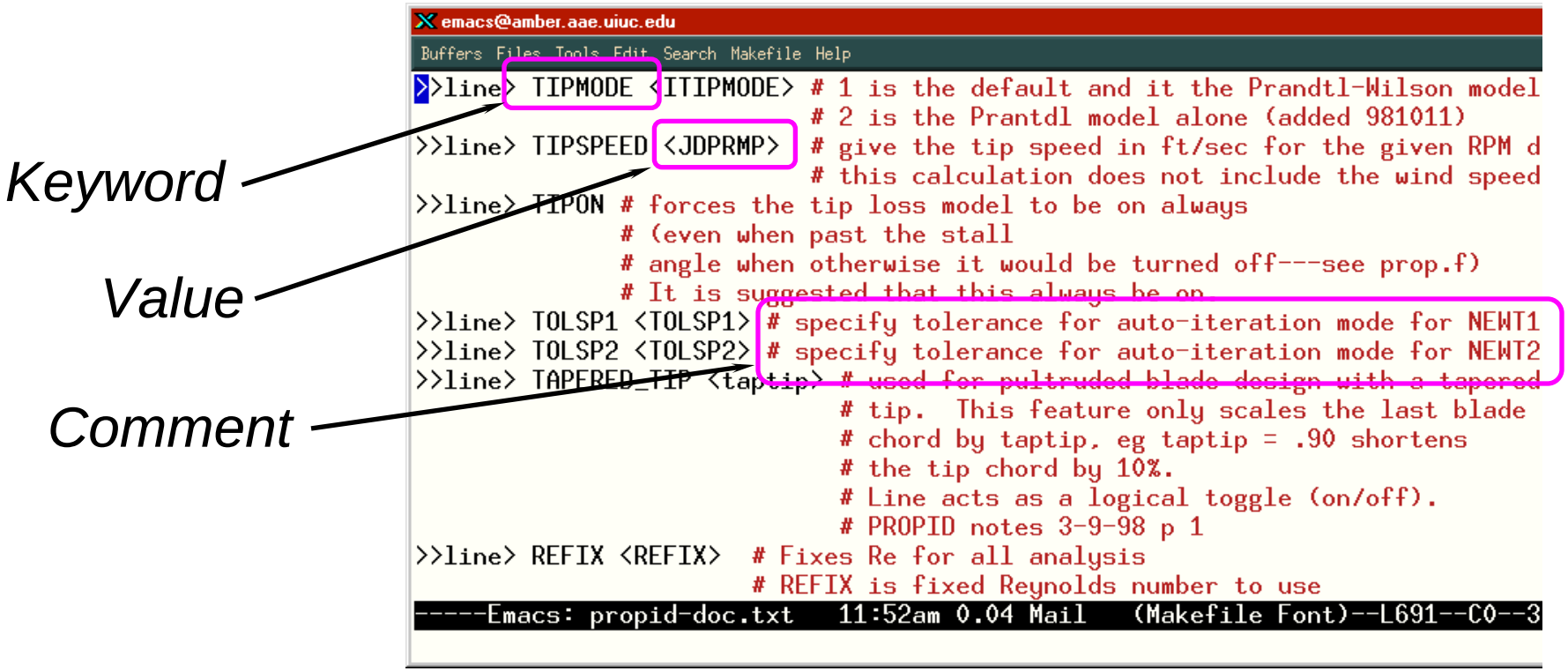


Documentation Sources

- Web based documentation at
  - http://www.ae.illinois.edu/m-selig/propid/
- The most current documentation for reference
  - propid-doc.txt
- Quick reference
  - propid-quickRef.txt
- wt-series input file descriptions
  - 00-wt-series.txt

Program Flow Control

- Uses a keyword journal-command structure
  - Screen grab from the manual: propid-doc.txt

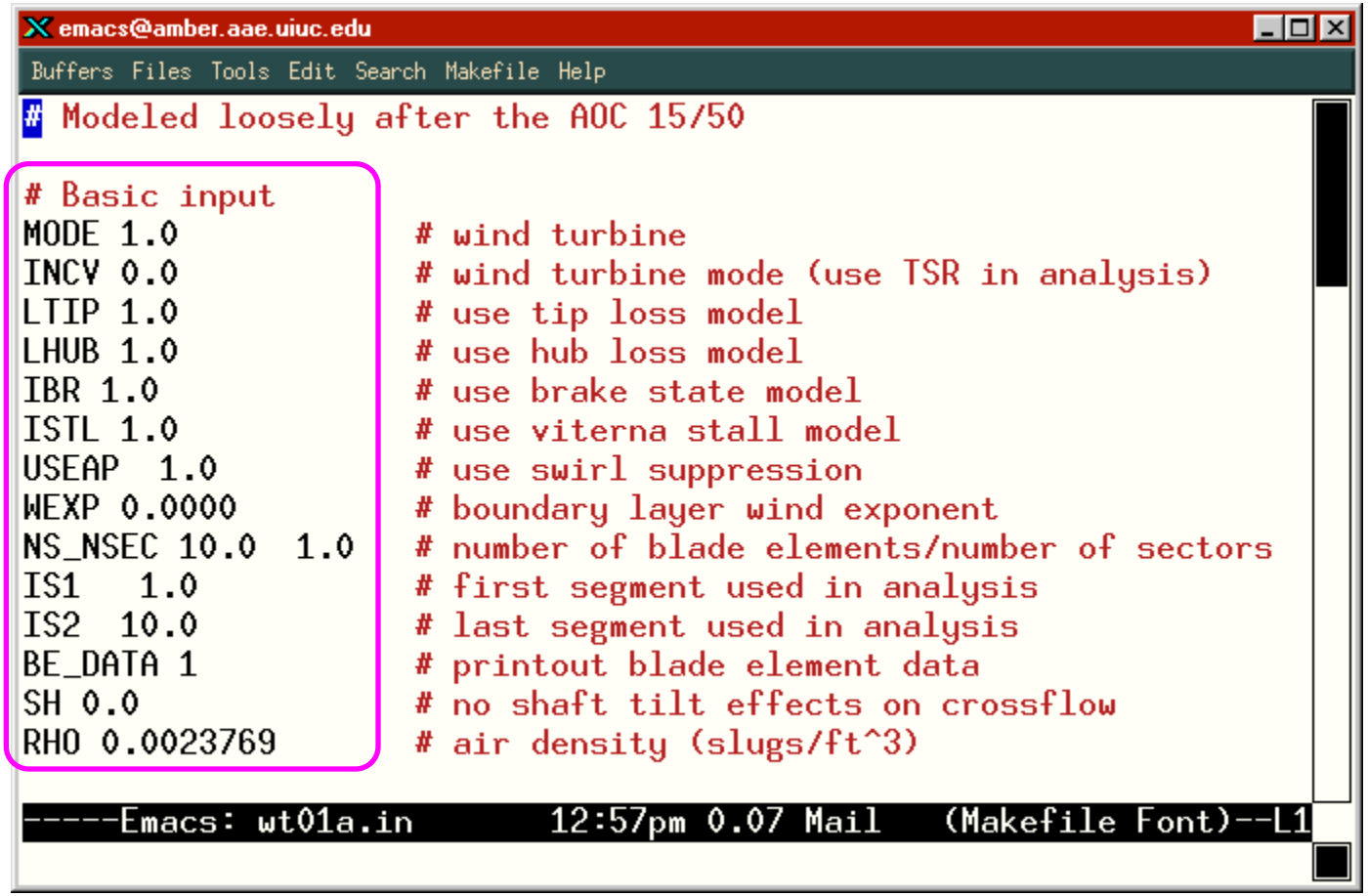


- Generates ascii text files at runtime

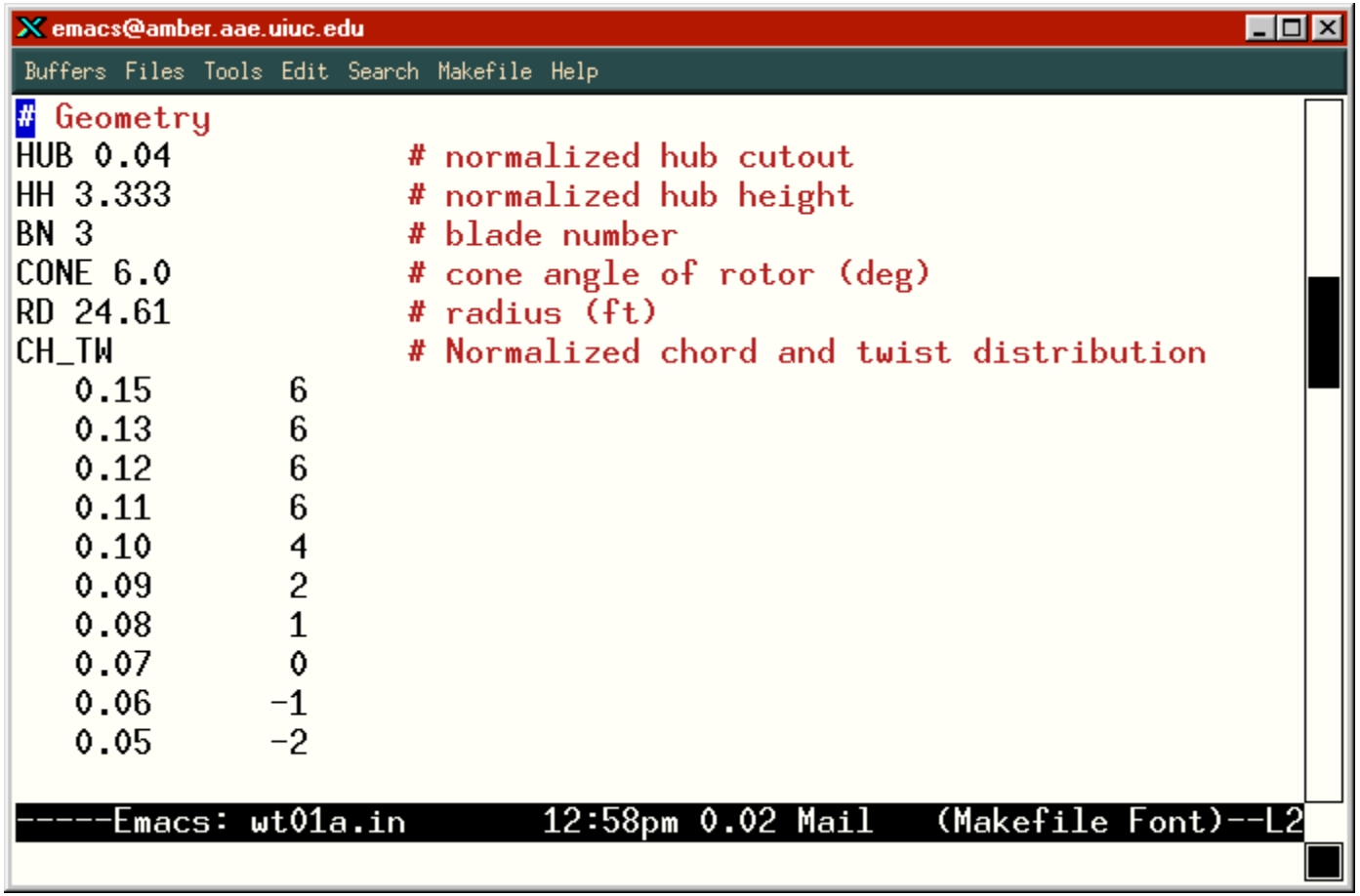
Input File Structure

- Basic Input Lines - A Walk through the File wt01a.in

All data similar to PROP



- Geometry Lines



- Airfoil Data Input - The process
  - Airfoil files are input

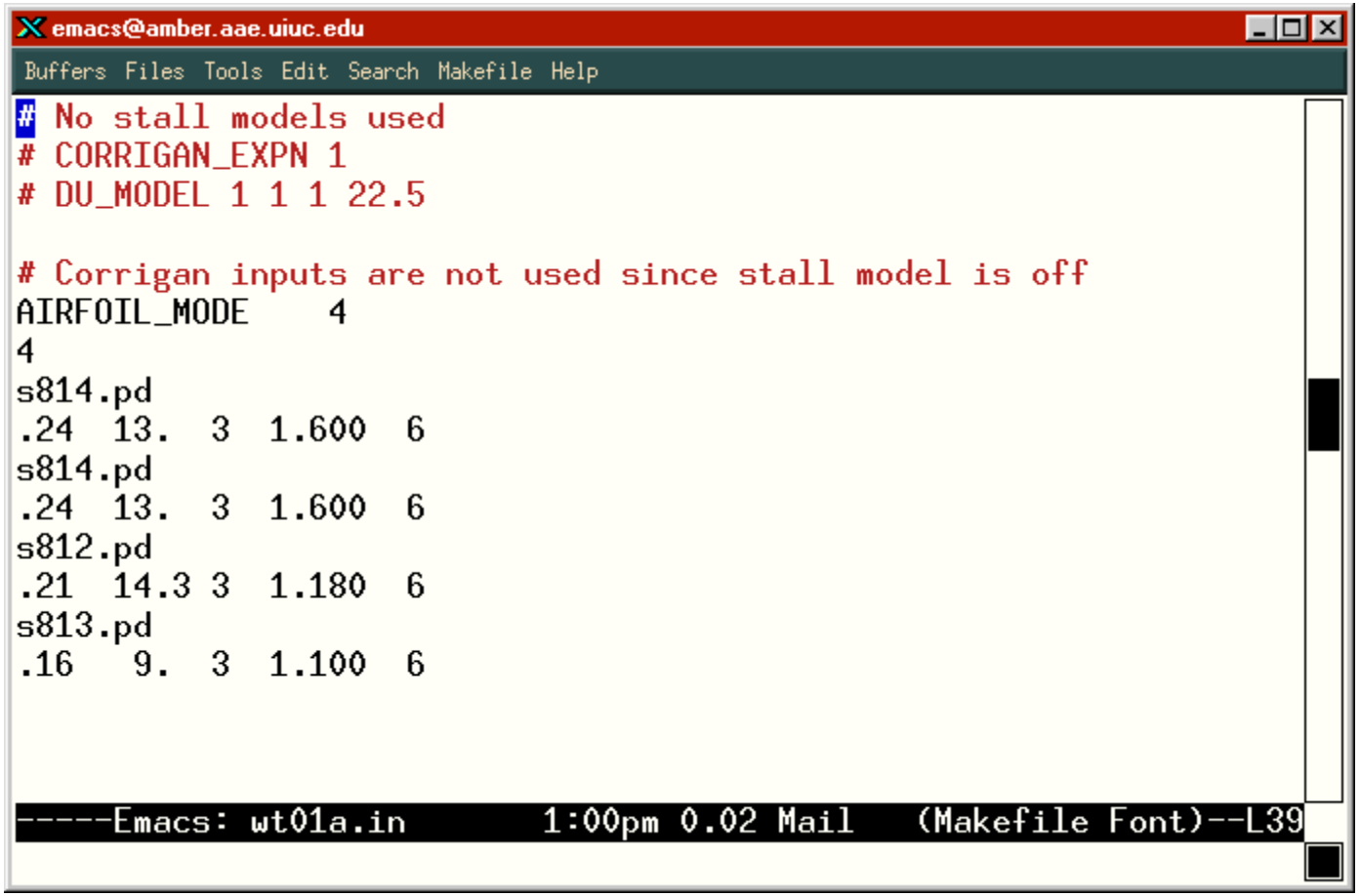
    => AIRFOIL_MODE line
  - Then they are assigned locations along the blade to make up the airfoil family

    => AIRFOIL_FAMILY line
  - More than one airfoil family can be specified

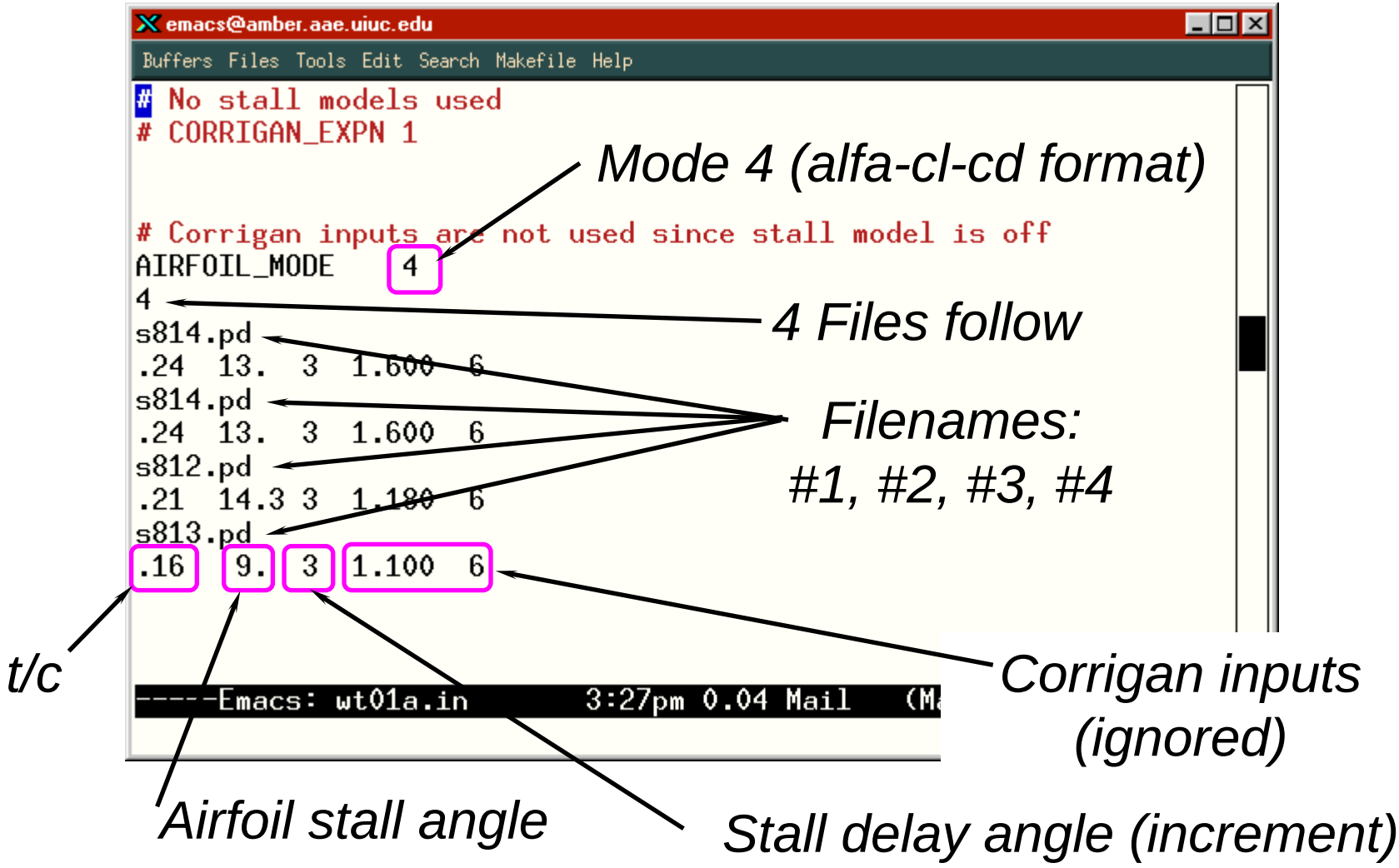
    => Additional AIRFOIL_FAMILY lines are allowed
  - Then specify which family to use

    => USE_AIRFOIL_FAMILY line

- Stall Models and Airfoil Data File Lines

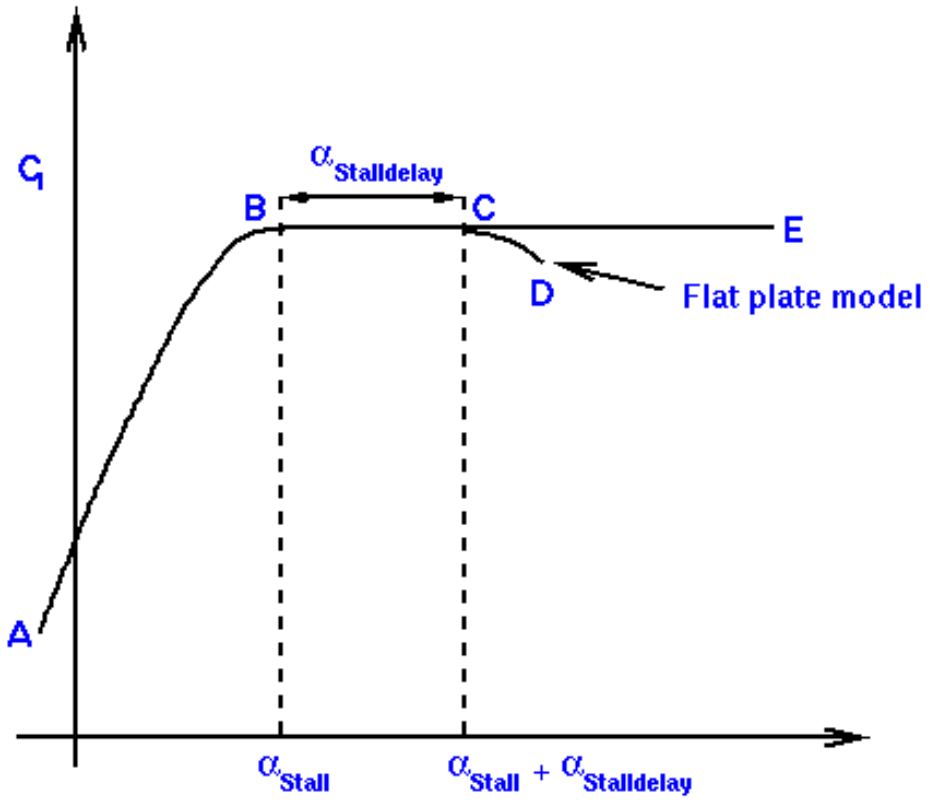


- Details

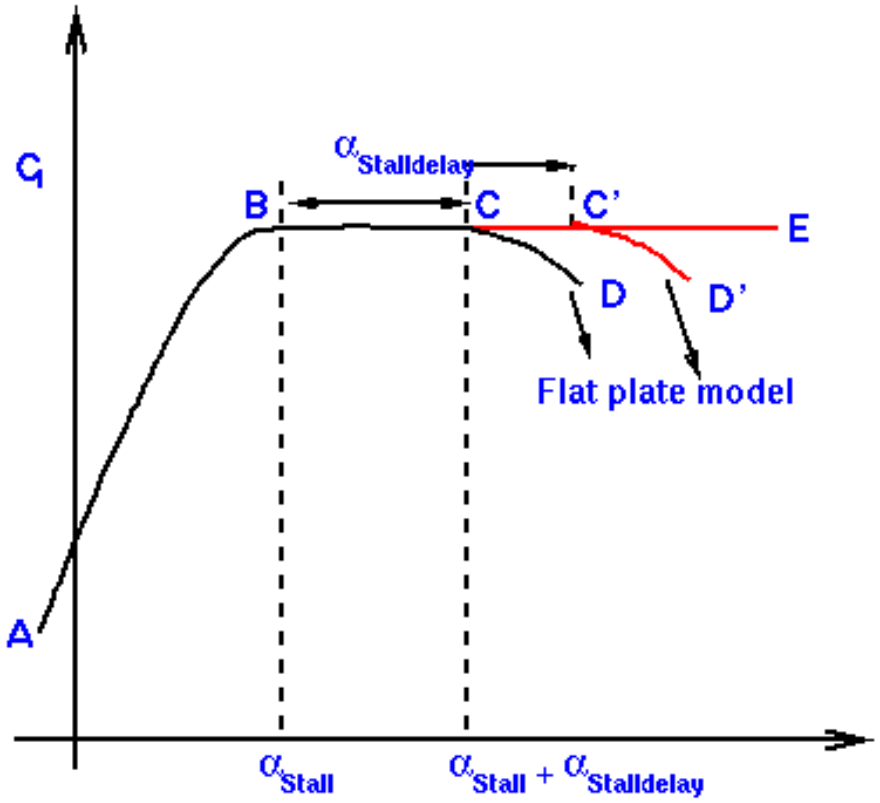

emacs@amber.aae.uiuc.edu
Buffers Files Tools Edit Search Makefile Help
No stall models used
CORRIGAN_EXPN 1
Corrigan inputs are not used since stall model is off
AIRFOIL_MODE 4
4
s814.pd
.24 13. 3 1.600 6
s814.pd
.24 13. 3 1.600 6
s812.pd
.21 14.3 3 1.180 6
s813.pd
.16 9. 3 1.100 6
-----Emacs: wt01a.in 3:27pm 0.04 Mail
Mode 4 (alfa-cl-cd format)
4 Files follow
Filenames:
#1, #2, #3, #4
t/c
Corrigan inputs
(ignored)
Airfoil stall angle
Stall delay angle (increment)

Detour:
Using the Stall Angle and Stall Delay Angle

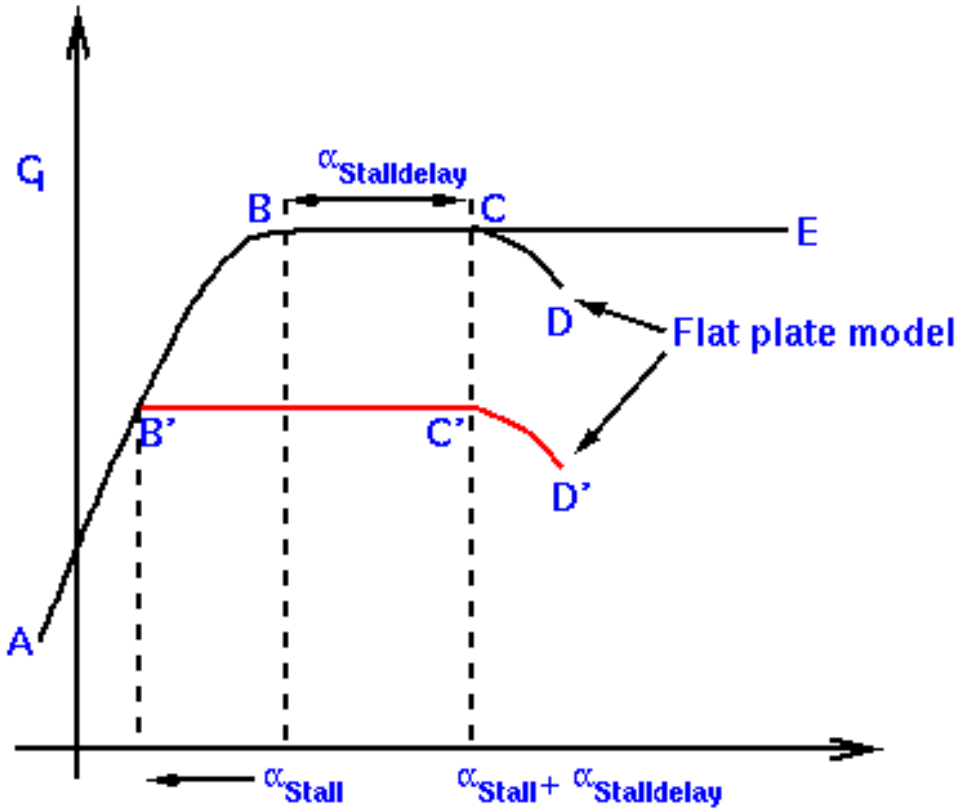
- Input data in .pd file:
  A-B-C-E
- PROPID uses:
  A-B-C-D
- Data past C from flat plate stall model
- Data from C-E ignored



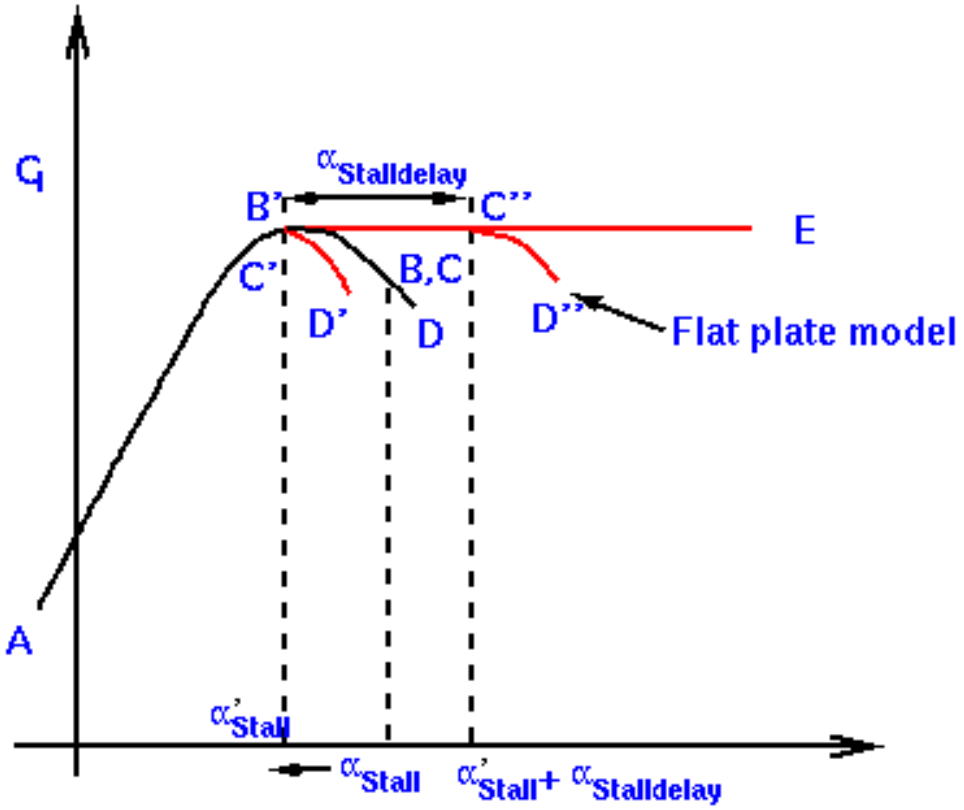
- Effect of increasing the stall delay angle C => C’ (models sensitivity to post stall effects)
- PROPID uses: A-B-C’-D’



- Effect of changing the stall angle B => B’ with a larger stall delay angle increment
  (models using lower lift airfoils)
- PROPID uses: A-B’-C’-D’



- To use only experimental data:
  - Set the stall angles to the experimental values (B)
  - Set the stall delay angle increment to zero (B = C)
- PROPID uses:
  A-B'-B/C

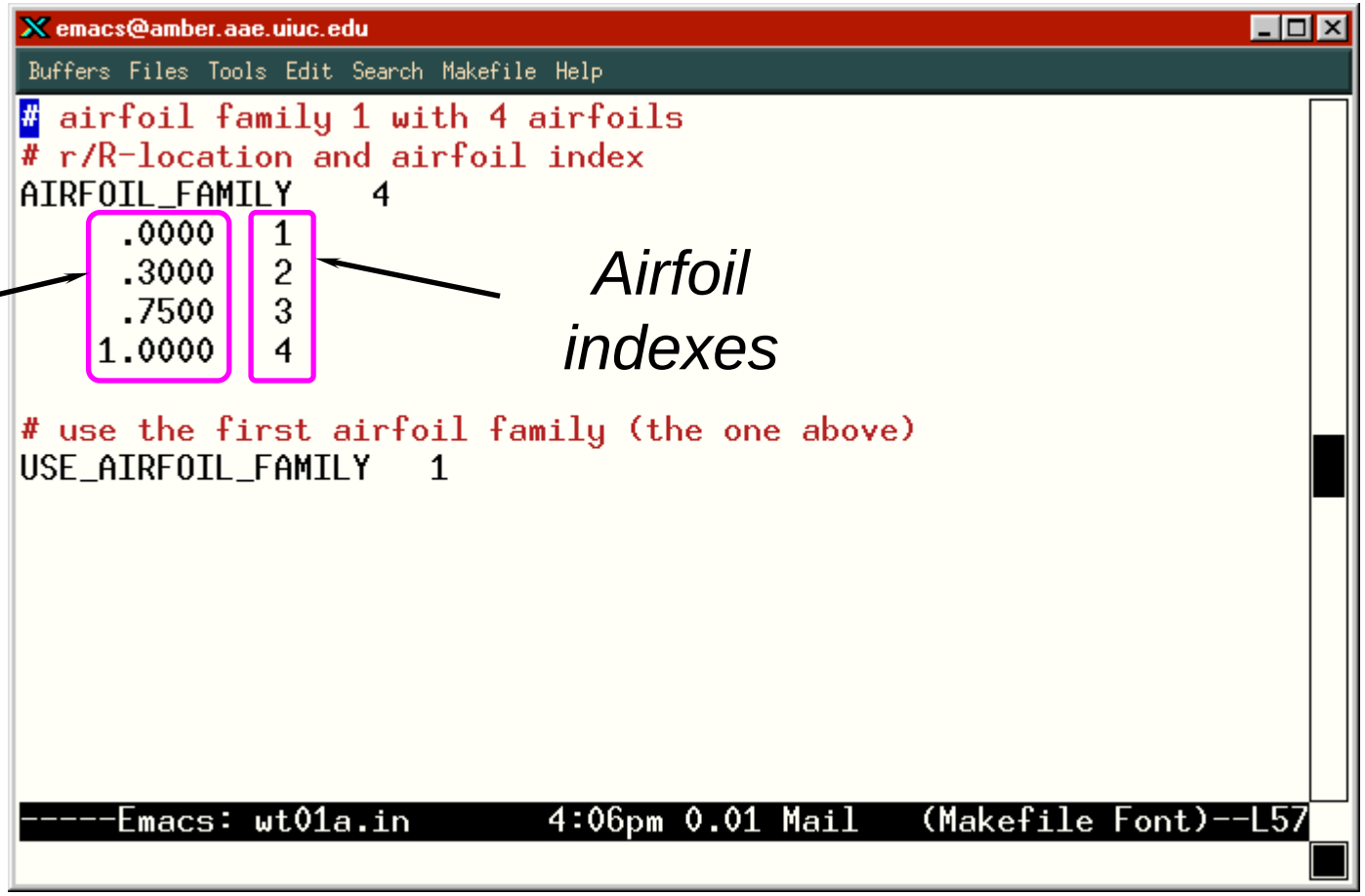


- PROPID Run: wt02a.in
  - wt02a.in includes
    - Lines to generate airfoil data as it is being used during the prop analysis => “A” data
    - Lines to generate airfoil data for use in PROP => “B” data
  - Change the airfoil stall delay angles and use PROPIDplotter_v10.xls to show the “B” data files
  - Uncomment the CORRIGAN_EXPN line to see the effect of turning on the Corrigan model
  - As changes are made, observe the changes in annual energy production as reported by the REPORT lines at the end of the file

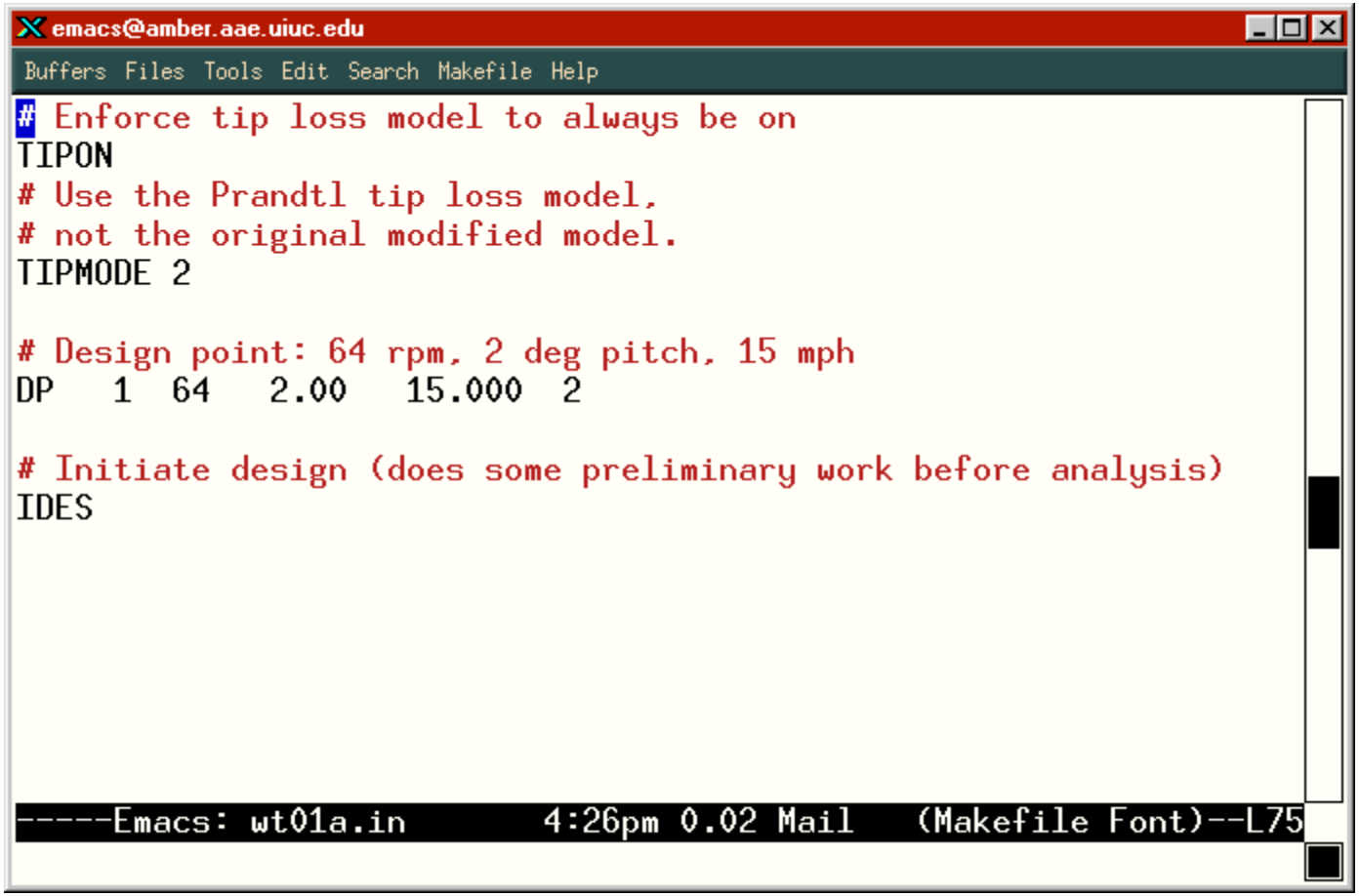
- Airfoil Family Lines

Airfoil locations

Airfoil indexes



- Tip Loss, DP and IDES Lines



- 2D_SWEEP Lines for Power Curve

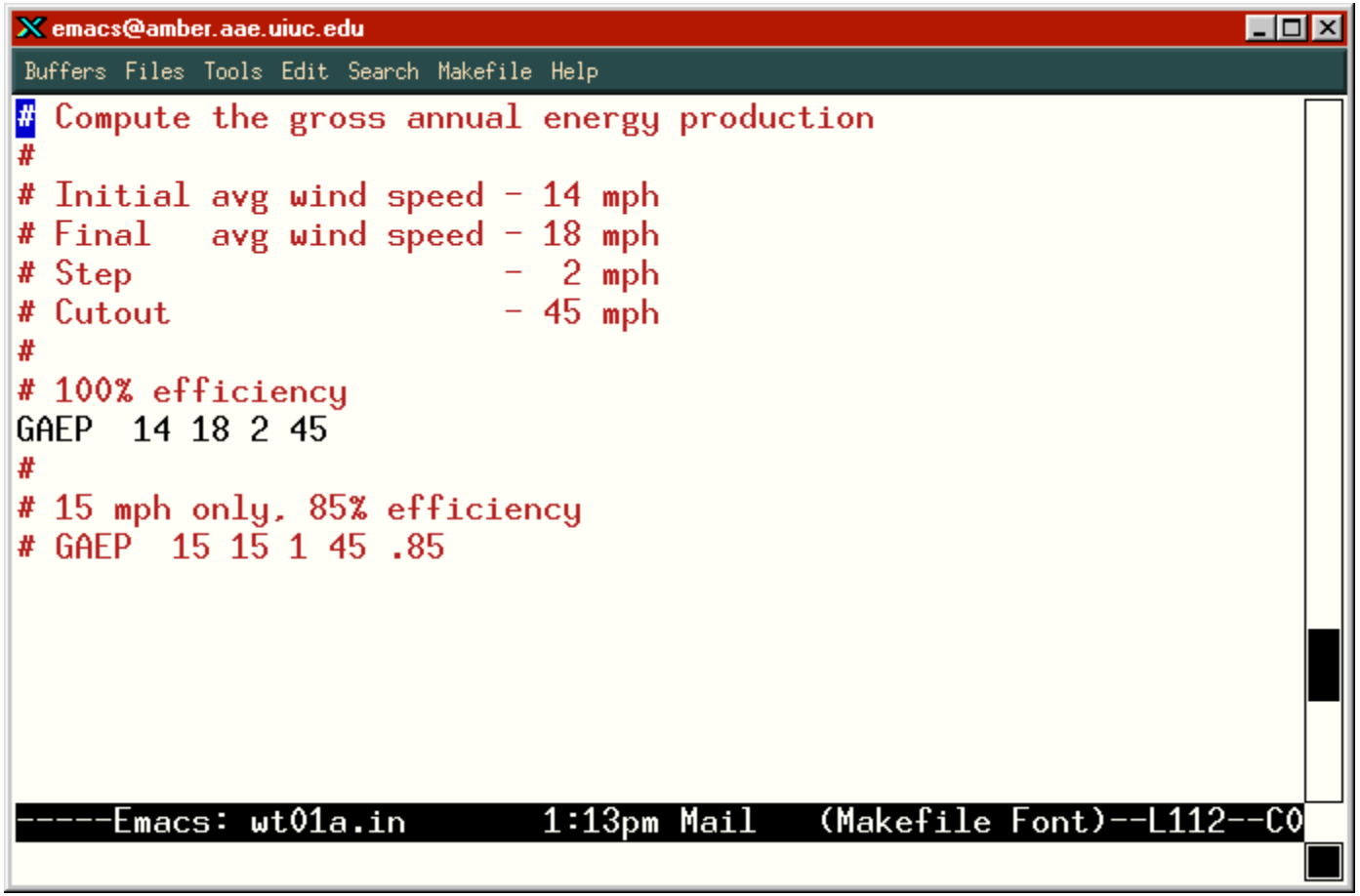
emacs@amber.aae.uiuc.edu

Buffers Files Tools Edit Search Makefile Help

```
# Determine the rotor power, cp, and thrust curves (2D_SWEEP)
#
# use pitch setting from design point (DP) 1
PITCH_DP 1
# use rpm from design point (DP) 1
RPM_DP 1
# sweep the wind from 5 to 50 mph in increments of 1 mph
WIND_SWEEP 5  50   1  2
# perform the sweep
2D_SWEEP
# write out
# 40 - power curve (kW) vs wind speed (mph)
# 45 - cp vs TSR
# 51 - rotor thrust curve
WRITE_FILES  40 45 51
```

-----Emacs: wt01a.in 1:05pm 0.04 Mail (Makefile Font)--L93

- GAEP Lines for Annual Energy Production



- 1D_SWEEP Lines for Blade Characteristics

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Buffers Files Tools Edit Search Makefile Help

```
# Obtain aero distributions along the blade (1D_SWEEP)
#
PITCH_DP 1
RPM_DP 1
WIND_SWEEP 5 30 5 1
1D_SWEEP
# write out
# 75 - blade l/d  dist
# 76 - blade Re   dist
# 80 - blade alfa dist
# 85 - blade cl   dist
# 90 - blade a    dist
WRITE_FILES 75 76 80 85 90
```

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- Blade Geometry Files and Dump File

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Buffers Files Tools Edit Search Makefile Help

```
# Write out
# 95 - chord dist (ft-ft)
# 99 - alfa  dist (ft-deg)
WRITE_FILES 95 99

# Write out the rotor design parameters to file ftn021.dat
DUMP_PROPID

*
```

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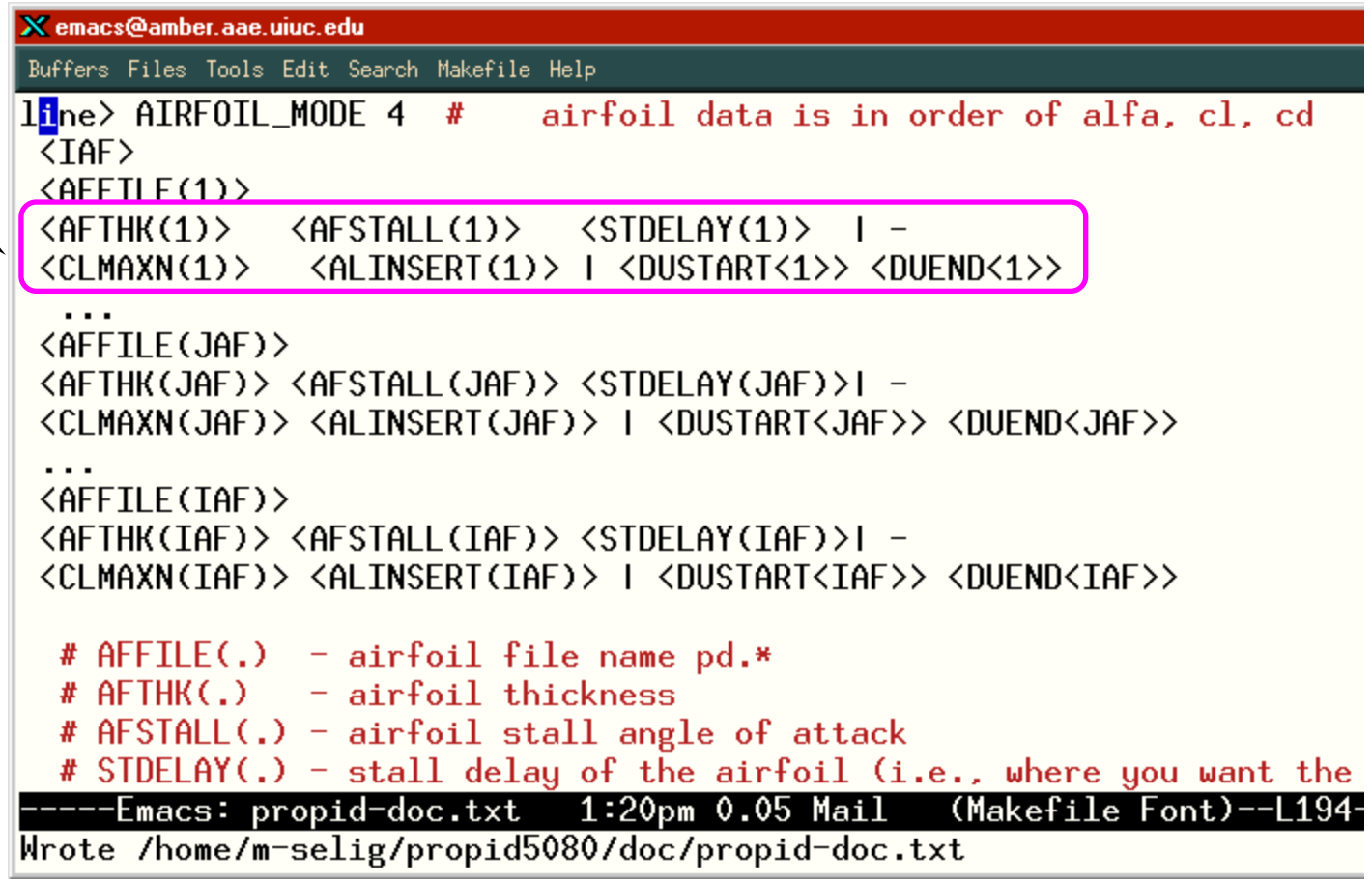
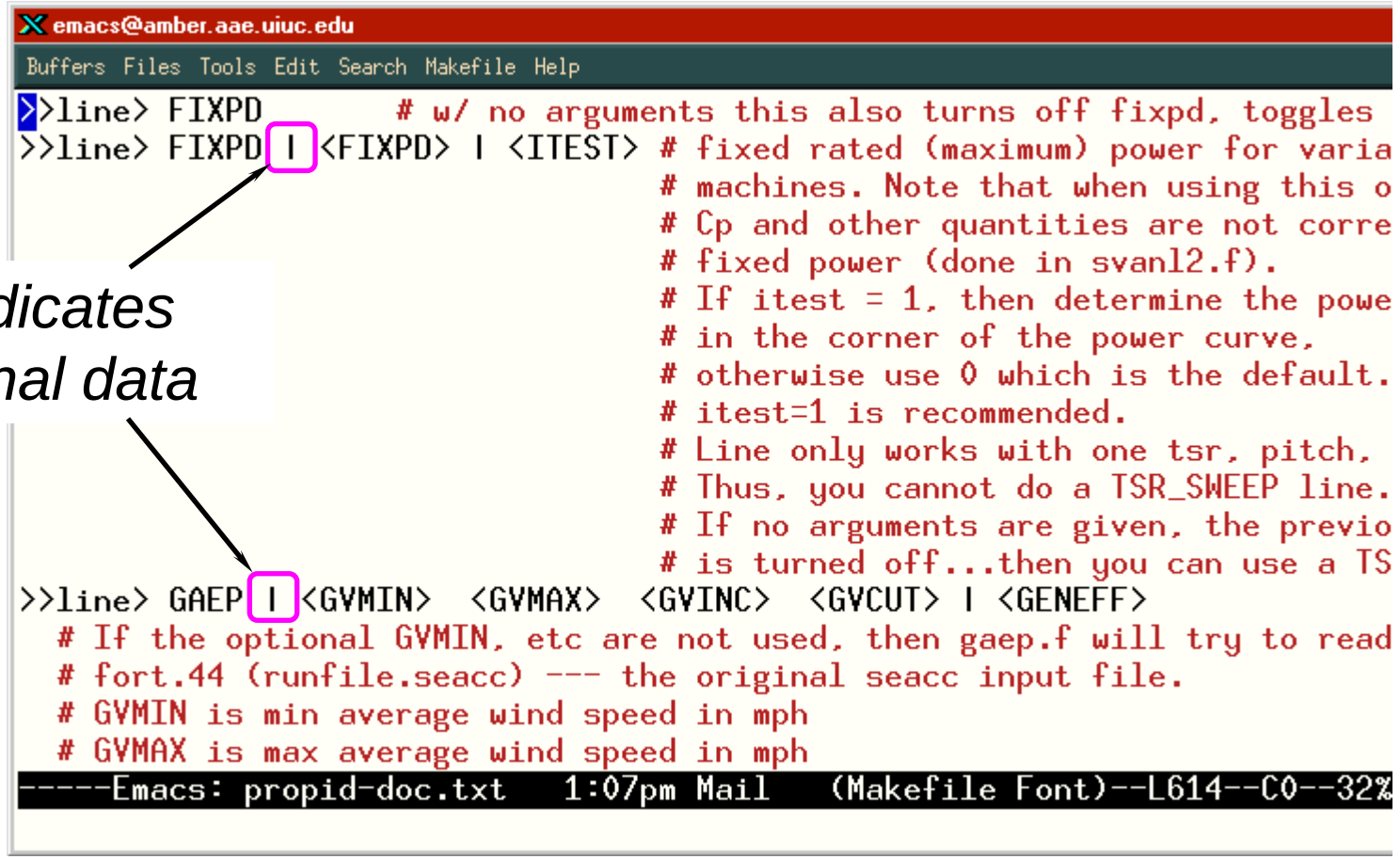
Misc. Notes

- propid-doc.txt syntax - line continuation '-'

All on one line in the input file



- Input lines with optional data / propid-doc.txt syntax



'|' *indicates optional data*

  - For example: 'FIXPD 700'
  - No inline comments: 'FIXPD 700 # will crash code'

- PROPID Run: wt03a.in
  - Analysis lines removed
  - Includes only geometry and airfoil data
  - Generates airfoil data at blade segments for use on other codes, e.g. PROP
- More cases are provided in the runs folder along with the short description of each case.
  See the file “00-wt-series.txt” for more details.
- See Part 2-3 to continue.