Matlab Data Structures
Manipulation of Structured Arrays

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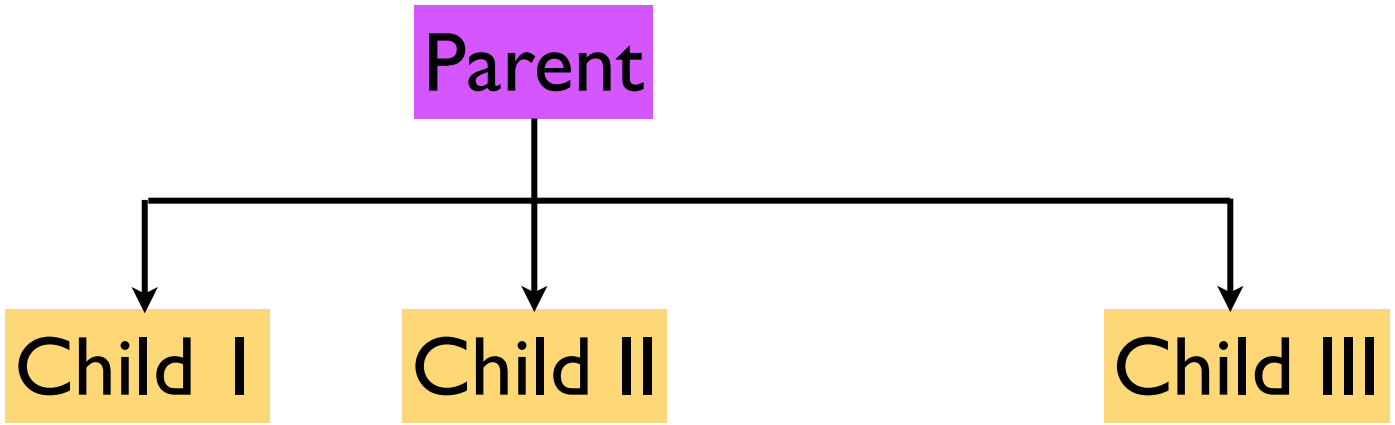
What is a Structured Array?

- Another Matlab data structure that can store dissimilar information (i.e., strings, numerics)
- A structured file (or struct file) is defined a parent-child relationship
- The parent structure contains high-level information about the data set
- "Children" branches contain detail information related to the parent



More Complex Example (Structured File)

In order to consider study the National Airspace System (NAS) we consider aircraft flight plans (fp) over the entire continental US . A sample flight explaining the requirements of the data stucture used in Matlab is explained in the sequel. All parameters of this flight have been derived from the Enhanced Traffic Management System (ETMS).

% The following example illustrates the ETMS data base

```
AAL1_______00_0 YYY B767 YYY YYY    1
AAL1_______00_0  JFK   LAX    40.640   73.779  866   33.943  118.408 1152  14:26   286 0 C  50
IZYYYYYY  40.633   73.783   0  866.000    123   123
YYYYYYYY  40.417   74.143 112  871.885    330   304
YYYYYYYY  40.200   74.500 208  875.749    386   345
YYYYYYYY  40.285   74.988 282  879.526    441   386
.....
LZYYYYYY  33.950  118.400   0 1168.621    219   225
```

More Complex Example (Structured File)

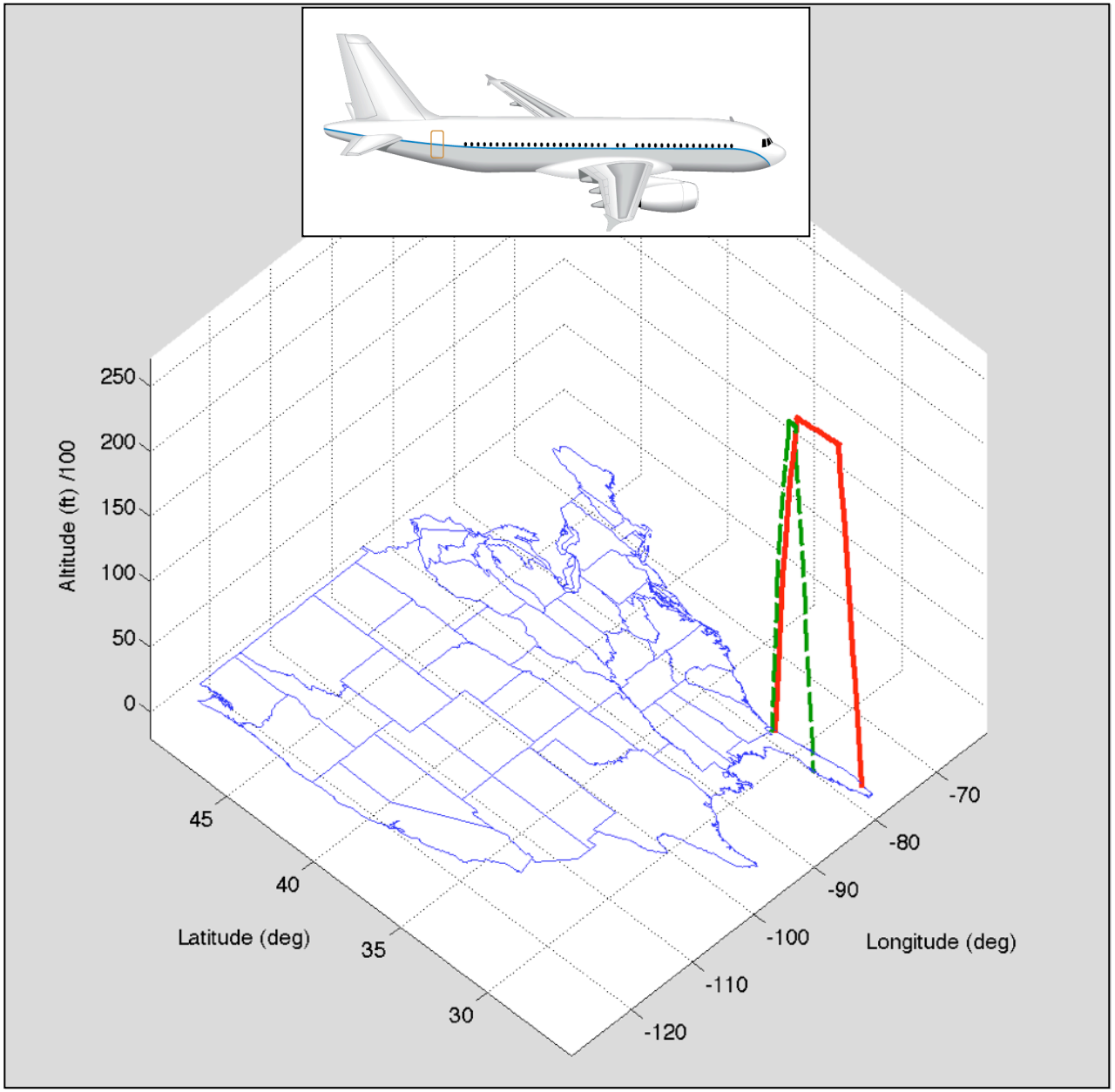
- Boeing 767-200
- Origin = JFK (New York)
- Destination - LAX (Los Angeles)
- Flight departure time = 866 UTC (minutes)
- 50 waypoints along the route are filed by the pilot in this case indicating a full trajectory from JFK to LAX
- The entire trip crosses 5-6 ARTCC centers in NAS and involves 2 terminal area crossings (at origin and destination airports)

A sample flight plan data structure file is available in the syllabus web site (flightPlanData.mat)

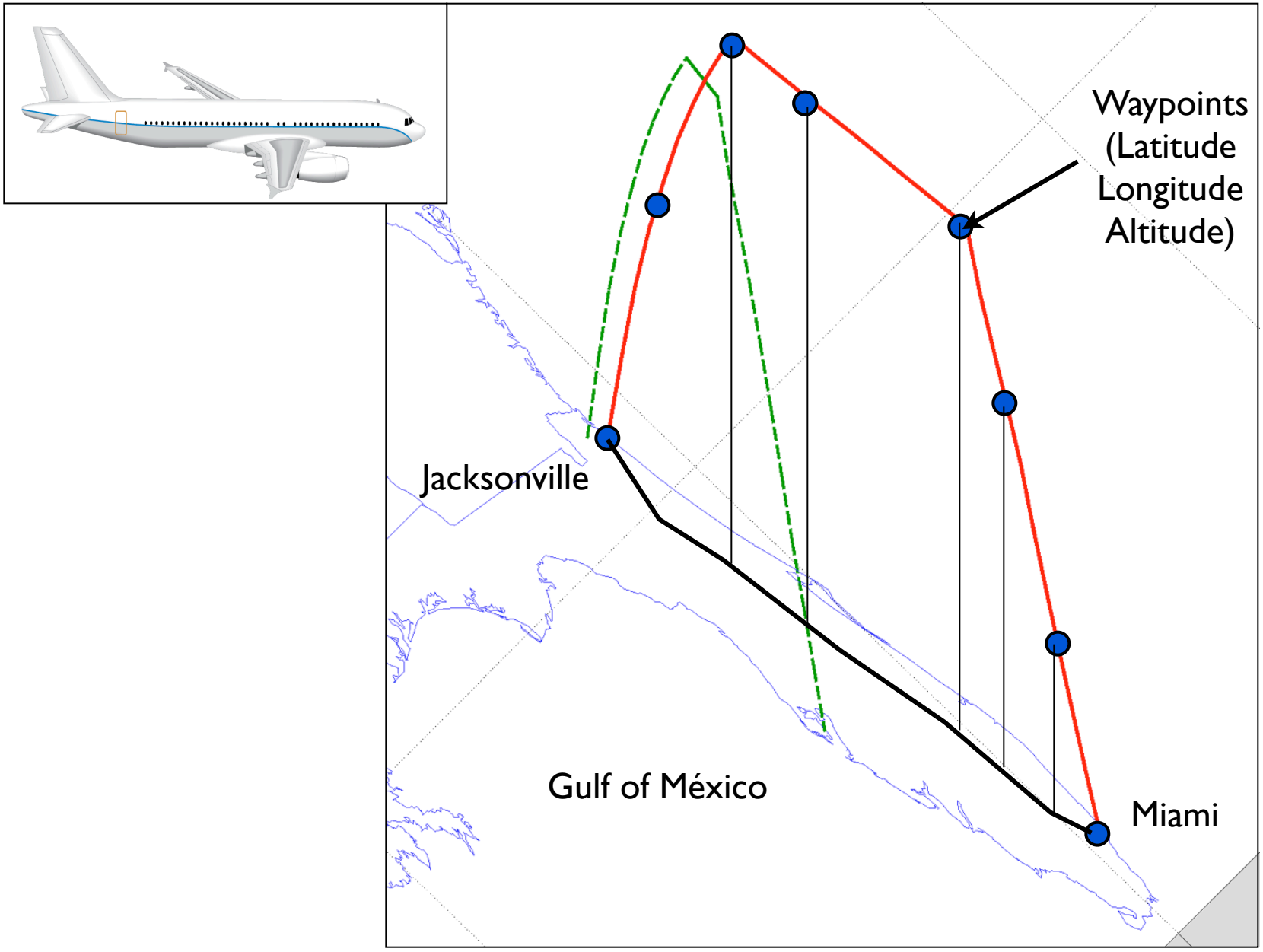
Explanation of a Flight Plan

Two flight plans shown in the graphic

Each flight plan has numerous waypoints along the route



Explanation of a Flight Plan and Waypoints



Structured File (flightPlanData)

flightPanData =

1x225 struct array with fields:
- fname
- fmodel
- origin
- destination
- n
- wp
- twp

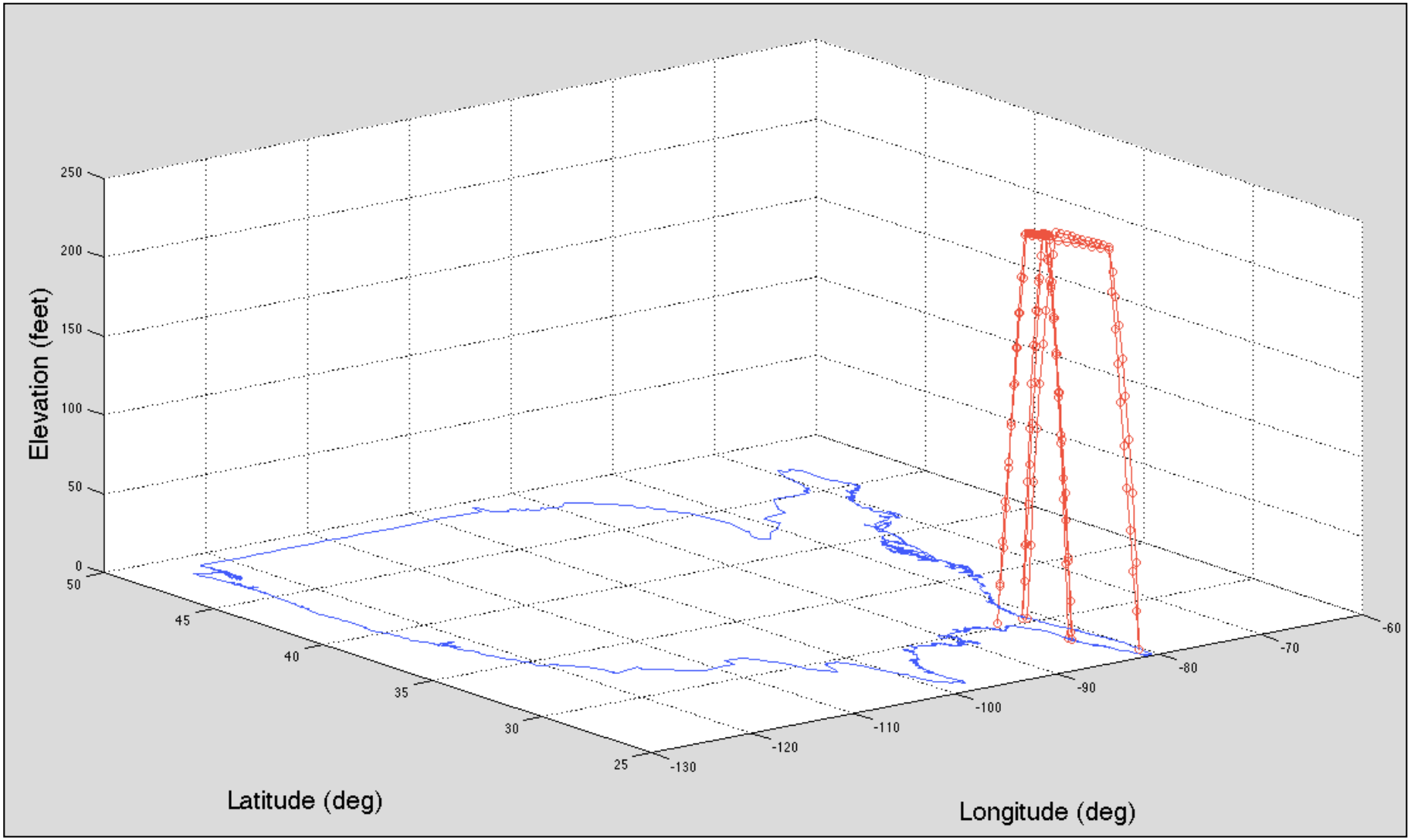
Parent data structure

Name	Data
fname	flight name
fmodel	aircraft type
origin	origin airport
destination	destination airport
n	number of waypoints (latitude, longitude, elevation)
wp	waypoints
twp	time at waypoints

Matlab Code to Manipulate Flight Plan Data

```
% Map has three vectors: latitude, longitude and elevation to make 3D plots

load flightPlanData     % loads the structure data
load usamap             % loads the coordinates of the U.S. boundary

% Make a plot of the US first. Then hold the plot to make a plot of the
% flights

plot3(uslon,uslat,elevation)
xlabel('Longitude (deg)','fontsize',20)
ylabel('Latitude (deg)','fontsize',20)
zlabel('Elevation (feet)','fontsize',20)
grid

hold on

% Now plot each flight.
% This requires a loop because the data is inside a struct file.
% This is one of one of the weaknesses of the struct files
```

Three-D Output Plot



A Few Tasks to Do:

- Plot the waypoints of all the flights in the data set
- Extract flights for a specific origin
- Plot the flights in 2D showing the vertical profile of the flight (side view)