From Data to Knowledge

A Journey Through The Mountains Of Information

Chris Frost

Mentor: Steve Norris

About Chris Frost

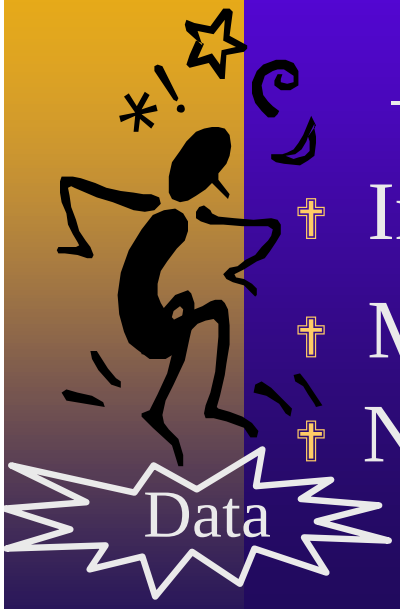
- School: The University of Virginia, Upcoming First Year
- Major: Computer Science
- Other Academic Interests: Engineering, Physics, and Mathematics
- Non-academic Interests: Running

Outline

- Introduction
- Development of Datalink Plotter
- Development of Wind Calc
- Related Projects
- Conclusions

Introduction

- Dynetics provides support for TUAV Project Office
  - Simulation
  - Flight test
  - Performance evaluation
- Information collected from tests is invaluable
- Magnitude of this data limits its usefulness
- New tools were required to solve these problems



Datalink Plotter

"In data analysis, a picture is worth a million rows of data!"

- Problem: UAV flights generate large volumes of hard to deal with information
- Datalink Plotter Goals:
  - Produce clean, intuitive plots so that data is easy to interpret
  - Automation of common tasks
  - Simpler, targeted interface

- Allows Dynetics and customers to have a deeper understanding of link data

Datalink Plotter Capabilities

- Architecture for reading any binary data
  - Currently supports the following data types found in the TUAV Datalink Specification
    - Bits
    - 8bit signed and unsigned integers
    - 16bit signed integers
- Allows plotting of multiple items, synchronized with time, for event comparison

Datalink Plotter Capabilities, Continued

- Data filtering through custom and pre-built binary masks
  - Communication links often use ranges of bits which have varying purposes
  - This filtering thus lifts interleaved messages of different repetition frequencies out of the larger data pool

Uplink Packet Content

- Always 52 bytes in length
- Different message types uplinked serially
  - 2Hz A
  - 2Hz B
  - 4Hz
  - 8Hz

Uplink Packet Content, Continued

- 2Hz A Example

Bit #	7	6	5	4	3	2	1	0
Byte 20	0	1	0					

  - Byte 20, bits 7, 6, & 5
  - Bytes 24 & 25: Altitude

- 2Hz B Contrast

Bit #	7	6	5	4	3	2	1	0
Byte 20	0	1	1					

  - Byte 20, bits 7, 6, & 5
  - Bytes 24 & 25: Gain and Level
- Result: Intertwined Data

Masking Example

Wind Calc

- Problem: Calculating wind data summaries from TUAV flights is a long, tedious process
- Wind Calc was created to find instantaneous, average, and interpolated wind summaries
  - With ability to easily be extended

Wind Calc Usage

- Three methods of interaction:
  - Single-entry call (filenames and time of event)
  - Interactive frontend
  - Batch frontend

Wind Calc Program Flow

Read data entries from high rate and low rate file repositories and perform averaging/interpolation

Convert coordinate system orientations

Save summarized data to ASCII file

Related Projects

- Variable Editor
- File Format Backend for Flight Visualization Tool
- Background Research in JMASS and sockets

Development of Variable Editor

- Purpose: Allow easy manipulation and plotting of equations for those not familiar with Matlab
- Capabilities:
  - Create and edit equations
  - On-screen input
  - Loading and saving of variables
  - Plotting

Variable Editor Interesting Concepts Explored

- Concurrency applied to a database concept
  - Wrote a light variable database with spinlocks
- Reentrant Guide Created Figures
  - Explored novel way to address graphical objects

File Format Backend For Flight Visualization Tool

- Dynetics is using a 3-D visualization tool to graphically demonstrate vehicle dynamics
- Began work to extend the program interface to deal with multiple file formats
  - Initially with support for SCD, JMASS, FTIP, and RAVIN
- Status: On hold pending availability of necessary software

Background Research

- Investigated porting JMASS to Windows 95/98/ME
  - JMASS uses the POSIX system call standard
  - Use Cygwin to support the system calls under Windows
- Sockets for using the flight visualization tool to display a flight in realtime

Lessons Learned

- Aspects of parallel programming
- Matlab
- Fortran
- UAVs
- GUI programming and design
- Designing, building, and delivering a product
- Life as a contractor vs. working in the Army
- Matlab GUI tools have a tendency to kill Win95/98

Conclusions

- People can gain a much deeper understanding of data, more quickly, through graphical means
  - Translating data to a usable form is the “key” to the mountains of data “lock” on information
- The development of these tools is already proving to be extremely helpful to Dynetics and the Army