Software Tools for Enhanced Collaboration at the DIII–D National Fusion Facility

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ENHANCED CAPABILITY MEANS

- Faster
- More efficient
- More productive
- Easier to use
- New possibilities
GAPlotObj AND MDSplus ENHANCE DATA VISUALIZATION AND ANALYSIS CAPABILITY

- **GAPlotObj**
  - Object-oriented library for dynamic plotting in IDL

- **MDSplus**
  - At DIII–D: a centralized repository for analyzed data

- Two example tools using GAPlotObj and MDSplus
  - **ReviewPlus**: general 2D and 3D data viewing
  - **EFITviewer**: rapid assessment of equilibrium fit from EFIT

- **Key benefit for collaborators**: site independence
GAPlotObj: AN OBJECT-ORIENTED LIBRARY FOR DYNAMIC PLOTTING

- Visualization tools at GA are written in IDL (from RSI)
  - Rich, easy to use language
  - Extensive, powerful interactive graphics

- GAPlotObj: IDL class library encapsulating dynamic plotting
  - Written by Data Analysis Applications group and Fanning Consulting
  - Used in many applications
  - Not IDL’s OpenGL-based “Object Graphics”

- Benefits to user
  - Interactive plotting = rapid feedback, no change of focus
  - Same interface in every tool
DYNAMIC PLOTTING WITH GAPlotObj

Five “Mouse Modes”

1) Select
   - Data values
   - Copy, delete
   - Math

2) Zoom
   - On Feature of interest
   - Toggle between single and multiple plots

3) Edit
   - Add, move, delete points in data trace

4) Cursor
   - Mark reference points

5) Slice
   - 2D & 3D Coupling
Move crosshairs from $t = 1400$ to $t = 3000$ ms

Crosshairs in time history slice plot also move

Profile slice plot changes from $t = 1400$ ms to $t = 3000$ ms

Image plot of $T_e$
MDSplus SIMPLIFIES DATA ACCESS

Conventional Storage

- Separate interface for each data type
- Must know data format and file location
- Data and context stored separately
- Hard to share results

MDSplus

- One interface to many data types
- Only need location of data in tree
- Store all relevant information
- Remote exploration of data productive
MDSplus SUCCESSFULLY DEPLOYED FOR DIII–D

- Stores analyzed data from 4700 shots so far
  - All shots since 1998 plus most popular old shots
  - 40 GB total file usage
  - Currently up to 16 datasets per shot (20 MB/shot), more being added

- Now using Unix MDSplus
  - Compaq DEC Alpha workstation (Tru64 Unix) with 100 GB RAID 5
  - Integrates more closely with Unix computing environment
  - Upgradable path for CPU and storage

- Most analyzed data loaded between pulses by event-driven system

- Can load at any time
ReviewPlus: GENERAL 2D AND 3D DATA VIEWING

- Data combinations
- Overplotting
- Any Y versus any X
- Math functions
- 2D and 3D coupling
- Signal menu and web help
- Automatic updating
EFITviewer: RAPID ASSESSMENT OF EFIT EQUILIBRIUM FIT

- Poloidal cross section of flux contours
- Tokamak and diagnostic geometry overlays
- Multi-shot overlays
- Time histories and profiles of EFIT results
- Fit quality
- Kinetic profiles
- Customizable display
MULTIPLE SITES AND SITE-INDEPENDENCE

- ReviewPlus and EFITviewer can run on DIII–D at any site with IDL and MDSplus
- Better for collaborator: run anywhere to view data from anywhere else
- Reviewplus can access data from any site with MDSplus
- EFITviewer is not fully site-independent
  - Can plot EFIT results from any site
  - But machine-specific geometry and diagnostic overlays
- Can use MDSplus to make EFITviewer site-independent
  - Store machine-specific information with data, not in code
Many codes can benefit
- EFIT
- TRANSP
- Theory and simulation

Discussions are underway between U.S. fusion sites to collaborate on tools of common interest
SUMMARY: GAPlotObj AND MDSplus ENHANCE COLLABORATOR ABILITY TO ANALYZE DIII-D DATA

- **GAPlotObj**
  - Interactive plotting = rapid feedback, no change of focus
  - Unified interface in all tools

- **MDSplus**
  - Simplified data access and storage
  - Remote exploration of data

- **Both used in ReviewPlus and EFITviewer**
  - Bring new capabilities to user
  - Can run at any site with IDL and MDSplus

- **Collaboration is the future of software in fusion community**
  - Run any code anywhere on any data from any site