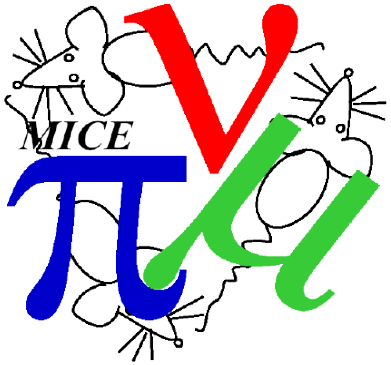
G4MICE Status and Plans



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G4MICE Status and Plans

- (Prioritised list of) Deliverables
- Work to date
- Issues
- Code infrastructure
- Work plan
- Resources

Deliverables (1)

1. **Global reconstruction**
   - Track fitting
   - Particle identification
   - Capable of working with any subset of detectors
   - Online and offline
2. **Calibration application(s)**
   - Generate a calibration from experimental data
3. **Tracking simulation of MICE**
   - At arbitrary level of detail
   - Model fields and detectors
   - NOT implementation of geometry

Deliverables (2)

4. **Physics analysis tools**
   - Extraction of accelerator physics parameters of interest from beam data (emittance, Twiss parameters, probably some more stuff)
   - Statistical manipulations (weighting, cuts, particle selection)
   - Transport mapping
5. **Data quality check**
   - Histogramming of DAQ output
   - Online and offline
6. **Electronics model of MICE detectors**
7. **Fast simulation of MICE (transport matrices)**
   - Envelope pushing
   - Response matrix calculation
8. **Event display**
   - Display of monte carlo output
   - Display of reconstruction output

Corollaries

- **QA process essential to:**
  - Prove code works
  - Bug diagnosis and fixing tool
  - Manage developer turnover
  - **> 50% of coding effort is to make tests and fix bugs**
- **Documentation**
  - Essential
  - Support users
  - Manage developer turnover
  - Manage developer cross-talk
- Geometry model
  - **G4MICE team will not provide manpower to develop geometry model of MICE**
  - We will work closely with whoever develops this model to ensure that UI is suitable and code has appropriate functionality

Work to Date

- To date we have reasonably complete
  - Tracking simulation of MICE
  - Electronics model
  - Physics analysis tools
  - Calibration applications
- Partially implemented
  - Fast tracking
- We are missing
  - **Global reconstruction**
  - Event display
- Crucially
  - **Testing is mostly non-existent**
  - **> 50% of coding effort is to make tests and fix bugs**

Issues

- General code infrastructure issues (1 = most severe)
  1. We don't know if the code works
     - Testing is patchy or non-existent
  2. We can't make a release
     - Tests which do exist are fragile
  3. We have no global reconstruction
  4. Developers leave and all their work is lost
     - Poor code documentation
     - No regression testing
     - Little unified style
  5. Development by different developers is duplicated or incompatible
     - Poor planning
     - Lack of management
- I am taking steps to address each of these issues

Code Infrastructure (1)

- Coding guidelines
  - Code must be written in a unified style
  - Code must be documented
- Unit testing
  - Each function must have a test associated with it
  - Tests must be reasonably complete
    - Aim for 100% test coverage
- Overall testing
  - Physics validation
  - Integration tests (does this app talk correctly to that app)
  - Load tests
  - GUI tests
  - User acceptance tests

Code Infrastructure (1)

- Rules
  - New code must obey coding guidelines
  - New code must have unit tests
  - QA manager will enforce these rules
  - **Code that does not obey these rules is not eligible for release**
  - **Propose: Code that is not in a release is not eligible for publication**
    - Theses or papers
    - Need endorsement from collaboration of this requirement

Code Infrastructure (2)

- Issue tracking
  - A list of open bugs and development items in progress
- Wiki
  - User level documentation
  - Developer level documentation
  - Installation instructions
  - Other information
  - Phone meetings
- Mailing lists
  - Two new mailing lists
    - g4mice-users@jiscmail.ac.uk for user support
    - g4mice-devs@jiscmail.ac.uk for developer communication
- Regular biweekly phone meetings
- Face-to-face meetings

Global Reconstruction

- Global Reconstruction task has been allowed to stall
  - Individual detector reconstructions exist
  - But probably not compatible
- Task is
  - Refactor detector reconstructions into a global framework
  - Testing of existing code
  - Implementation of global track fitting and PID
- **Critical Issue**
  - **No one at a senior level with appropriate experience in G4MICE team**
- Issue
  - RecPack does pattern recognition using Kalman filter
    - T2K pattern recognition code
  - RecPack documentation is poor
  - RecPack seems to be unsupported

Summary Work Plan

- Detailed work plan is in progress but not yet ready
- Work estimates below
  - Highly dependent on who is performing the task
- Unit tests of existing code **(~18 months)**
  - Probably involves some refactoring work
- Global reconstruction **(~18 months)**
  - Refactor detector reconstructions into a global framework
  - Implementation of global track fitting and PID
  - System tests
- Tracking simulation **(~4 months)**
  - Spill structure
  - Input beam
  - Updated physics list
  - System tests

Summary Work Plan

- Electronics model **(~2 month)**
  - Soft code all cabling information
  - System tests]
- Physics analysis tools **(~4 months)**
  - Weighting tools
  - Mapping tools
- Event display **(~6 months)**
  - Display of hits
  - Display of geometry
  - Display of trajectories
  - Display of envelopes
- Detector calibration **(?)**
- Online Interfaces and Controls **(~6 months)**

Summary Work Plan

- Fast simulation (matrix pusher) **(~6 months)**
  - Calculation of matrix by field derivative
  - UI for material model
  - Material types and geometries
  - Code refactoring
- Infrastructure **(~4 months)**
  - Config DB Interface
  - File IO system
- Management **(~2 month/year** over 4 years**)**
  - Release management
  - Regression testing
  - Infrastructure and support
- **Total 76 months + ?**
  - Some work can be prioritised out
  - Some jobs have probably been missed off the list

Resources

- Historically, G4MICE team has maintained about 2-3 FTE
  - Typically senior post-doc manager
  - Post-docs and graduate students as work force
- **Critical Issue**
  - **Detector team dissolves Spring next year**
    - Contracts expire, students graduate
  - This is sometimes poorly documented and tested code
  - Back to square one
  - **Overall manpower severely reduced**
- My effort must be concentrated on accelerator side
  - Funding comes from generic Neutrino Factory R&D

Summary

- By my estimation, G4MICE is about 50% “complete”
  - After 8 years work
- Major hole is global reconstruction
  - With current manpower it will not be possible to develop global reconstruction algorithm
  - No 6D emittance measurement
  - Limited PID
- Major hole is testing
- **Serious mismatch of manpower, experience to task in hand**
  - **High risk to MICE goals**