Relativistic Heavy Ion Collider

Brookhaven National Laboratory

Date: August 26, 1996

To: Workshop participants

From: Steve Peggs Steve P.

Subject: Report of the 1996 Accelerator Modeling Mini-Workshop

Cc: Don Barton, Kevin Cahill, Tom Clifford, David Finley, Mike Harrison, Steve Holmes, Waldo Mackay, John Marriner

Please find the report of the mini-workshop attached to this cover memo, in the form of a RHIC Accelerator Physics note, RHIC/AP/111. It is also available on the web at www.rhichome.bnl.gov/RHIC/RAP/ap_notes/index.html

The mini-workshop was held "with the hope of identifying areas of cooperative development" between various software projects:

- accelerator controls (Fermilab, RHIC)
- TEAPOT++ package (Cornell, RHIC)
- CLASSIC collaboration (Fermilab, [CERN, DESY, SLAC])
- Model presentation and GUI interfaces (Tech-X)

In addition to the RHIC participants at the workshop, there were 4 visitors from Fermilab, 2 from Cornell, and 2 from Tech-X. Tech-X is a small start-up company, in Boulder, Colorado. Their software project is currently funded by a phase I SBIR.

The mini-workshop was very successful, both in allowing an interesting and fruitful exchange of information, and in demonstrating that, yes, there are significant grounds for cooperation and collaboration. We loosely agreed that we would try to meet again, probably in early 1997, and probably at Fermilab.

RHIC/AP/111
August 1996

Report of the 1996 Accelerator Modeling Mini-Workshop

RHIC, BNL, 14 - 16 August, 1996

Editor: Steve Peggs

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Introduction

Steve Peggs

The workshop was held in order to informally address the following topics:

1. evaluate the RHIC effort to establish an instantiated accelerator model that is accessible to both the control system and to simulation codes
2. discuss similar activities at Fermilab during the Main Injector era, with the hope of identifying areas of cooperative development
3. develop a clear plan for the next round of TEAPOT and SMF (Standard Machine Format) development.

Further information about the goals, (nominal) agenda, and the participant list, may be found in the Appendix to this report.

The mini-workshop was small enough that most presentations and round table discussions were held in "plenary" sessions. Nonetheless, we divided up into the following 4 working groups, listed below with their chairs:

1. TEAPOT++ Development Timetable (Richard Talman, Cornell)
2. CLASSIC/PAC and CLASSIC/SMF interfaces (Jim Holt, Fermilab)
3. On Line Modeling (Bob Joshel, Fermilab)
4. Model Presentation and GUI (John Cary, Tech-X)

The brief conclusions of these working groups may be found in the pages immediately following this Introduction.

As the mini-workshop came to a close, the consensus was (seemed to be) that, indeed, there are significant grounds for informal cooperative efforts between Cornell, Fermilab, RHIC, and Tech-X. It was informally agreed that we would try to meet again, probably in early 1997, and probably at Fermilab.

Finally, it is my pleasure as editor of this report to thank all of you who made the mini-workshop intellectually stimulating and productive. Special thanks go to Pam Manning, who was responsible for the smooth running of the mini-workshop.

TEAPOT++ Development Timetable

Richard Talman, Cornell

Phase 1: Lattice description and raw tracking

SMF, C++ representation		
Teapot++ tracking engine		
Pac/Perl environment (some portability)		
SMF, Ascii Perl representation		
Prototype legacy → SMF migrator (CESR)		
Code control and distribution	β	Sep

Phase 2: Analysis and correction

Analysis		
closed orbit		
numerical maps		
Twiss eigenanalysis(4×4)	α	Dec
Global correction		
tune (additive and multiplicative)		
chromaticity (additive and multiplicative)		
decouple – options	α	Dec
Local correction		
adjuster & (super)Detectors		
orbit smoothing		
local decoupling	α	Feb
Error assignment – Monte Carlo, meas., simul.,	α	Dec
Tracking control (Perl)	α	Dec

Graphical post-processing

Minimal: backward compatibility lattice (7), Twiss (4), tracking (8)	α	Dec
Preferable: improved graphical functionality, reliability, portability, flexibility, interactability, resonance identifiability (xpot, xpix, turnplot)		

Support for space charge calculation

bundle space charge, beam-beam, intra-beam splitting controlled by application (not complexity index) interpolate beta functions include longitudinal (dist. no force)	N/A	
parasitic crossing locator (ftpot?)		

Miscellaneous

helical orbit support (ftpot ?)
linking to ctpot via Perl
FNAL Recycler using Teapot++ (Phase 1)
misc. FNAL support

CLASSIC/SMF and CLASSIC/PAC interfaces

Jim Holt, Fermilab

The primary question which was discussed was: Is there a correspondence between CLASSIC and SMF? (Or can they work together?)

Action Items

1. Compare data structures/header files between the two. Holt(CLASSIC) / Malitsky(Cornell) / Satogata(BNL)

   Try to exchange files before CAP'96 (in Williamsburg, September '96). Plan to discuss differences at CAP'96.

2. Document differences/similarities by sometime in October.

PAC/CLASSIC

1. If memory(CLASSIC) to memory(SMF) mapping can take place, then communication can take place via PAC.

2. The two could also be bolted together via parsers/factories.

Open question: What is the relationship (if any) between CLASSIC and ZLIB++?

On Line Modeling

Bob Joshel, Fermilab

Goal

On-line modeling consists of the use of a model/simulator–in the accelerator control room–to expose, study, and solve tuning problems with the real machine. ONLM(On-Line Model) refers to the infrastructure and codes to provide this.

Why?

Sharing components of on-line modeling offers: ability to build more powerful diagnostics with limited resources, use of tools that have been validated and therefore give a higher degree of confidence, ... etc.

Attributes

1. Layer components of ONLM to invite sharing. (Codes should be published and free.)
2. The ONLM is part of the accelerator control system.
3. Provide a method to switch between ONLM and the real machine.
4. Allow multiple algorithms (calculation engines) within the ONLM.
5. ONLM should be able to export results to a standard format so they may be shared or saved, ... etc.
6. Allow the use of the off-line modeling codes within the ONLM.
7. Provide user-interface for display and interaction with the ONLM. (This is an alternative to using control system applications to interact with the ONLM.) This would also support access to parameters in the model/simulator that have no analog in the control system.
8. Use a standard format and protocol to communicate between the layers of the ONLM.

Notes

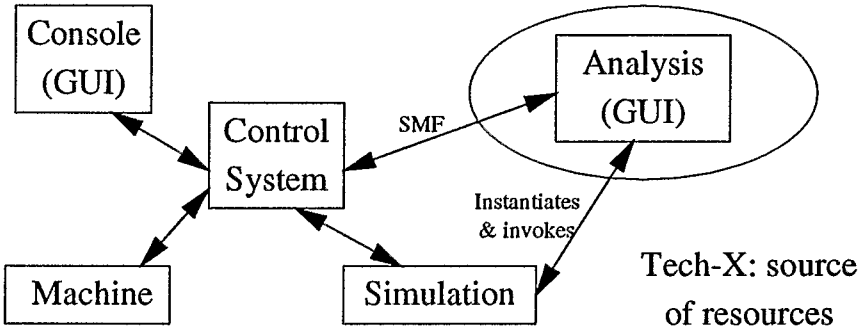
There are semantic differences in the meanings of 'model' and 'simulator'. Hence, these words have been blurred together here.

In the absence (or until) there is a 'standard', the ONLM should use well-described formats and protocols to allow for conversion codes to be generated. This will invite future movement to a standard.

We agreed that item 8 is the challenge. Our viewpoints and technology may not yet support this activity.

Model Presentation and GUIs

John Cary, Tech-X



- There is a need for a graphical user interface (GUI) for file building, parameter setting, model invocation, and results presentation as per the circled area of the above diagram. A difficulty is the lack of resources for carrying this out. This can be alleviated by code sharing and bringing in other funding sources. Any such development should adhere to modern software standards of being decomposable and object oriented.

- Tech-X via an SBIR project provides a mechanism for funding such work, but there must be a path to commercialization in order to obtain this source of funding. Tech-X has a GUI, OOP application (mapa) that has been used for accelerator modeling. Cornell has an existing object oriented accelerator modeling code (PAC/TEAPOT++) that will grow to being fully featured, and that could be instantiated within mapa, so that the mapa GUI invokes PAC/TEAPOT++ methods. ZLIB++ maps could also be implemented in mapa.

- Furthermore, mapa could be modified to do post-processing of files generated by batch run accelerator physics codes.

- Tech-X will implement tracking with TPSA representations of lattices using ZLIB++ within their existing GUI code, mapa, in collaboration with Cornell, BNL and FNAL. This will be completed by then end of September, 1996.

- Tech-X will instantiate PAC/TEAPOT++ within their existing GUI code, mapa, in collaboration with Cornell, BNL, and FNAL. This will be completed by the end of December, 1996.

- The commercialization path for the results of these products would vary. Accelerator physics specific products would be licensed freely. Products developed for the general task of rendering would be licensed freely to collaborators, but would also be commercialized for external markets to meet the requirements of Phase II SBIR funding. Tech-X would also provide support and upgrades as contracted.

Relativistic Heavy Ion Collider
Brookhaven National Laboratory

July 18, 1996

Colleague,
Institution

Accelerator Modeling Mini-Workshop
RHIC, BNL, 14 - 16 August, 1996

Dear Colleague,

I am pleased to invite you attend a mini-workshop on Accelerator Modeling, to be held in the RHIC Collider Center, BNL building 1005, from Wednesday August 14 through Friday August 16. The goal of this workshop is to:

1. evaluate the RHIC effort to establish an instantiated accelerator model that is accessible to both the control system and to simulation codes
2. discuss similar activities at Fermilab during the Main Injector era, with the hope of identifying areas of cooperative development
3. develop a clear plan for the next round of TEAPOT and SMF (Standard Machine Format) development.

The common time scales and modeling issues shared by RHIC and the Main Injector/Recycler continue to be quite striking.

Pam Manning will be happy to answer any questions you may have concerning travel to Long Island, and local lodging. We recommend flying into MacArthur/Islip airport, if possible. For your convenience, should you wish to stay on site, we have reserved a block of rooms at the BNL guest house. Fulvia Pilat and Garry Trahern will be helping Pam as local workshop organizers.

Attached please also find a tentative agenda, and a list of workshop participants. We look forward to seeing you soon!

Sincerely,

Steve Peggs,

516-344-3104
peggs@bnl.gov

AGENDA

The Thursday and Friday agendas are (especially) flexible! Talks are mostly scheduled for 20 minutes, plus 5 minutes for questions and answers.

Wednesday, August 14 - Controls Modeling

9:00	Steve Peggs	Introduction, and workshop scope
9:15	Garry Trahern	Accelerator databases at RHIC
9:40	Bob Joshel	Modeling & controls: the problems & the future
		(break)
10:35	Nikolai Malitsky	Introduction to PAC
11:20	Fulvia Pilat	SMF modeling of RHIC
11:45	Todd Satogata	SDS and SMF
		LUNCH
1:30	John Cary	GUI C++ code for accelerator modeling
1:55		Discussions, work

Thursday, August 15 - Accelerator Physics Simulation

9:00	Richard Talman	TEAPOT status and plans
9:25	Shekhar Mishra	Recent simulation results
9:50	Glenn Goderre	Simulation in the control room
		(break)
10:45	Wolfram Fischer	Helical dipoles, tune modulation, space charge
11:10	Jie Wei	Interaction region quadrupoles
11:35	Fritz Dell	The RHIC dynamic aperture
		LUNCH
1:30		Discussions, work
4:00	Jim Holt	The weekly RAP Seminar: "The C++ Accelerator Modeling Collaboration, CLASSIC"

Friday, August 16

9:00		Discussions, work
		LUNCH
1:30		Discussions, work
3:00	Peggs (chair)	Round table wrap-up

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