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Introduction to the Polymorphic Tracking Code

Fibre Bundles, Polymorphic Taylor Types and "Exact Tracking"

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Abstract

This is a description of the basic ideas behind the "Polymorphic Tracking Code" or PTC. PTC is truly a "kick code" or symplectic integrator in the tradition of TRACYII, SixTrack, and TEAPOT. However it separates correctly the mathematical atlas of charts and the magnets at a structural level by implementing a "restricted fibre bundle." The resulting structures allow backward propagation and recirculation, something not possible in standard tracking codes.

Also PTC is polymorphic in handling real (single, double and even quadruple precision) and Taylor series. Therefore it has all the tools associated to the TPSA packages: Lie methods, Normal Forms, Cosy-Infinity capabilities, beam envelopes for radiation, etc., as well as parameter dependence on-the-fly. However PTC is an integrator, and as such, one must, generally, adhere to the Talman "exactness" view of modelling. Incidentally, it supports exact sector and rectangular bends as well. Of course, one can certainly bypass its integrator and the user is free to violate Talman's principles on his own; PTC provides the tools to dig one's grave but not the encouragement.

The reader will find in Appendix B a PowerPoint presentation of FPP. The presentation is a bit out of date but it gives a good idea of FPP which is essential to PTC. FPP is a stand-alone library and can be used by anyone with a FORTRAN90 compiler.

This presentation is also, to be honest, a place where the authors intend to document very incompletely nearly two years of work: the development of FPP and subsequently that of PTC.

Our ultimate intention is to morph PTC completely into MAD-X. The code MAD-X is an upgrade of MAD-8 and not of the C++ CLASSIC based code MAD-9. The present document does not address when and how this will be done. It is also our goal to link, if possible, PTC with CAD programs for the design of complex follow-the-terrain beam lines. So far FPP and PTC have been used in the design of beam separators (complex polymorphs) and recirculators. They have also been linked with the code BMAD from Cornell. There is still a lot of work to be done if these tools are to be generally usable by a wide range of people.

In addition, more complex structures will be needed to handle effects beyond single particle dynamics in a way which respects the fundamental mathematical integrity of the structures of PTC.

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