

A new approach to the solution of the vacuum magnetic problem in fusion machines

L. Zabeo^{a,*}, G. Artaserse^b, A. Cenedese^{c,d}, F. Piccolo^a, F. Sartori^a,

JET-EFDA contributors

^a EURATOM/UKAEA Fusion Association, Culham Science Centre, Abingdon, Oxon OX14 3DB, UK

^b Association EURATOM-ENEA-CREATE, DIMET Univ. Mediterranea di Reggio Calabria Via Graziella,
Loc. Feo di Vito, I-89060 Reggio Calabria, Italy

^c EURATOM-ENEA Consorzio RFX, C.so Stati Uniti 4, I-35127 Padova, Italy

^d University of Padova, Department of Management and Engineering, Stradella San Nicola 3, I-36100 Vicenza, Italy

Received 31 July 2006; received in revised form 16 April 2007; accepted 17 April 2007

Available online 7 June 2007

Abstract

The magnetic vacuum topology reconstruction using magnetic measurements is essential in controlling and understanding plasmas produced in magnetic confinement fusion devices. In a wide range of cases, the instruments used to approach the problem have been designed for a specific machine and to solve a specific plasma model.

Recently, a new approach has been used for developing new magnetic software called FELIX. The adopted solution in the design allows the use of the software not only at JET but also at other machines.

In order to reduce the analysis and debugging time the software has been designed with modularity and platform independence in mind. This results in a large portability and in particular it allows using the same code both offline and in real-time.

One of the main aspects of the tool is its capability to solve different plasma models of current distribution. Thanks to this feature, in order to improve the plasma magnetic reconstruction in real-time, a set of different models has been run using FELIX.

FELIX is presently running at JET in different real-time analysis and control systems that need vacuum magnetic topology.

© 2007 Elsevier B.V. All rights reserved.

Keywords: Vacuum magnetic problem solution; Machine independent

1. Introduction

For an optimum control of a tokamak discharge an accurate evaluation of the plasma parameters needs to be performed. One of the main objectives is the identification, with high accuracy, of the plasma boundary.

* Corresponding author. Present address: JET-Culham Science Centre, Abingdon, Oxon OX14 3DB, UK.

E-mail address: lzabeo@jet.uk (L. Zabeo).

The control of the vertical position and the shape of the plasma, for example, requires precise plasma boundary geometric parameters including x -point (upper and lower in case of quasi double null configuration), strike-points (separatrix crossing position in the divertor region) and gaps (distance between vessel and plasma boundary). High time resolution in the reconstruction is also required due to the dynamics of the plasma evolution.

Usually the design of the algorithms and codes is strongly machine dependent allowing their use only for a specific machine. A different point of view has been adopted in order to develop a set of tokamak independent tools without any specific JET information embedded. All the needed data are stored in a configuration database where a clear detailed model of the tokamak is provided. Then this database is used to build the real-time application.

A new code sort called FELIX has been recently developed. FELIX is a collection of tools that allows a real-time code to be constructed from the description of a tokamak.

The first section shows how the magnetic problem for a generic machine can be addressed. The second focuses on the real-time codes aspects of the algorithm. In the third some examples of the models implemented for the JET plasma boundary are reported.

2. Magnetic problem approach

A machine-oriented approach has been removed from the design of FELIX. The idea of developing a simple machine-independent instrument for solving the problem of magnetic reconstruction has resulted

in a collection of hierarchical databases implemented on computer files using a human readable syntax. The function performed by the algorithm is completely determined by the information contained in three databases: Machine Configuration File (MCF), Program Configuration File (PCF) and Transitional Configuration File (TCF).

FELIX can be considered as a collection of algorithms able to move from the description of the machine contained in the databases into a runnable program.

2.1. Machine Configuration File, MCF

The main database, called Machine Configuration File, includes a detailed description of a machine from the magnetic point of view. The geometry of the electro-magnetic elements of a machine in addition to information about how the power supplies, the coils and any external discrete components are connected to form the circuits, are collected in the database. The plasma geometry parameters to be reconstructed, such as the definition of gaps, are also part of the stored information.

The MCF database is organised into groups:

- Elements: concentrated elements, generators, combined coils, etc.
- Circuits: the connection between elements of the tokamak circuits.
- Geometry: elements and structures of the machine.
- Plasma: measurements of the plasma geometry.

Each group includes a collection of objects described by a given set of rules in a script language fashion. An example is shown in Fig. 1 where the

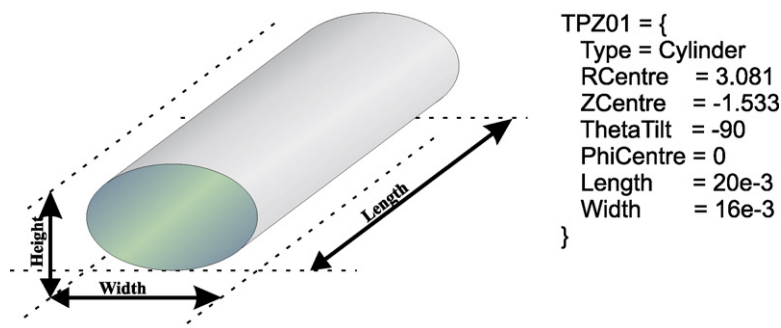


Fig. 1. Coil model approximation and equivalent description using the rules adopted in the MCF Geometry group.

Download English Version:

<https://daneshyari.com/en/article/273293>

Download Persian Version:

<https://daneshyari.com/article/273293>

[Daneshyari.com](https://daneshyari.com)