

## Hands-on session

Gianmaria De Tommasi<sup>1</sup>

<sup>1</sup>Associazione EURATOM/ENEA/CREATE  
DIS – Università degli Studi di Napoli Federico II  
[detommas@unina.it](mailto:detommas@unina.it)

November 26<sup>th</sup> 2009

**4<sup>th</sup> GOTiT High Level Course**  
**Magnetic Control of Tokamak Plasmas**

## Plasma linearized model of JET tokamak

The linearized plasma model used in this session is

$$\delta \dot{x} = A\delta x + B\delta u$$

$$\delta y = C\delta x + D\delta u$$

where the state and input vectors are given by:

$$\delta x = \begin{pmatrix} \delta I_{PF} \\ \delta I_E \\ \delta I_p \end{pmatrix} \quad \text{and} \quad \delta u = \begin{pmatrix} \delta V_{PF} \\ \delta V_p \end{pmatrix}$$

The outputs are the shape descriptors (gaps, strike-points and x-points).

## PF circuits at JET

The first 10 elements of the state vectors are the currents in the PF coils

- $I_{P1}$  - current in the  $P1$  circuit
- $I_{P4}$  - current in the  $P4$  circuit
- $I_{IMB}$  - imbalance current in the  $P4$  circuit
- $I_{PFX}$  - current in the  $PFX$  circuit
- $I_{SHP}$  - current in the shaping circuit
- $I_{D1}$ ,  $I_{D2}$ ,  $I_{D3}$ ,  $I_{D4}$  - currents in the divertor coils
- $I_{FRFA}$  - current in radial field circuit

## Linearized model

Download the model from

[http://wpage.unina.it/detommas/GOTiT/HandsOn\\_DeTommasi.zip](http://wpage.unina.it/detommas/GOTiT/HandsOn_DeTommasi.zip).

In the .zip file there are:

- `plasmaModel.mat` - it contains the model matrices and the equilibrium state and output vectors.
- `drawVessel.m` - this function draws the JET vessel.
- `drawPlasma.m` - this function draws the plasma.

## Effect of the current in the PF coils on plasma shape

- evaluate the effect of PF coils current variation on plasma shape
- plot the plasma shape variations corresponding to current variations in the PF coils
- choose a circuit to control ROG (Right Outer Gap)
- choose a circuit to control plasma current

## Design a simple ROG control

Try to design a control system for ROG control.

Use P4 as actuator.