

PTCOG 46



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Centre de Protonthérapie d'Orsay

EAGLE, an infrared registration system for patient positioning

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Thank you to:

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Medical Physicists

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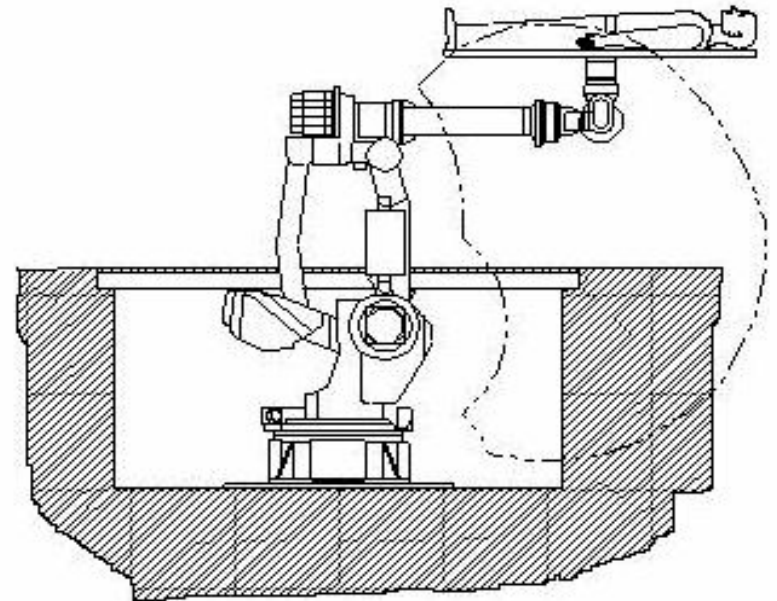


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I. Context

Context at CPO

Real 6 degrees of freedom (DOF) Patient Positioner



First medical robot for protontherapy (A. Mazal et Al., 1995)

Context at CPO

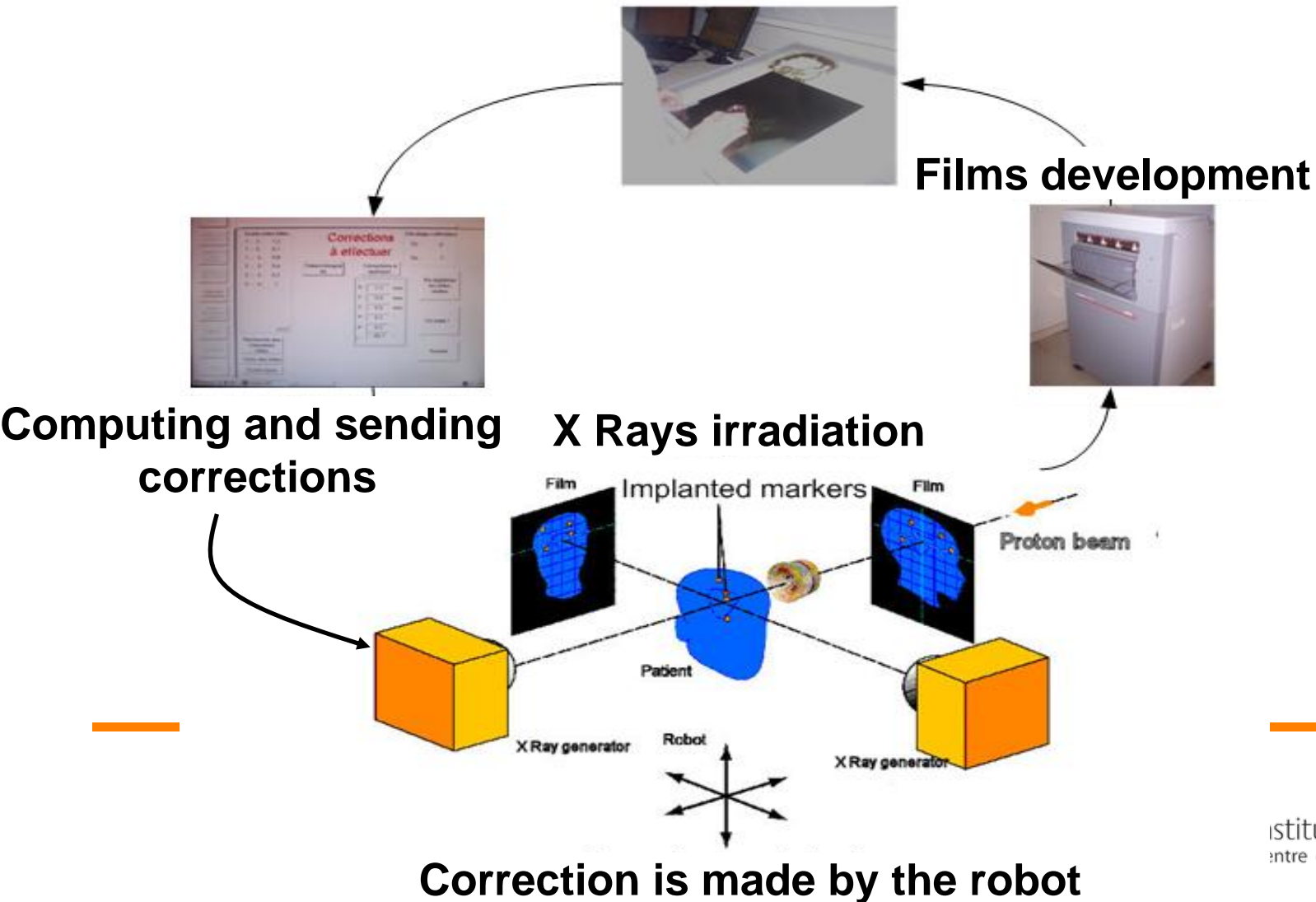
- Sessions with multiple fields for head and neck tumors
- Lack of repeatability of immobilization device in the tolerance required (<1.5mm)
- Difficulties to reach directly the required position
- Iterative positioning with X-Rays

Developments on positioning systems at CPO

- Improve the cooperation between the therapist and patient positioner
- Therapist is not “a robotic specialist”
- Standard communication between each systems
- Saving patient data in a general patient database

Standard CPO positioning protocol

Digitalization of X Rays films



Standard CPO positioning protocol

- Positioning iterations made by X-Rays imaging
- 25min per field
- Unuseless X-Rays exposure for the patient (2 to 4 films per field)
- Implanted gold markers





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II. Hardware description

NDI Polaris infrared localizer



Accuracy ~0.2mm in translation

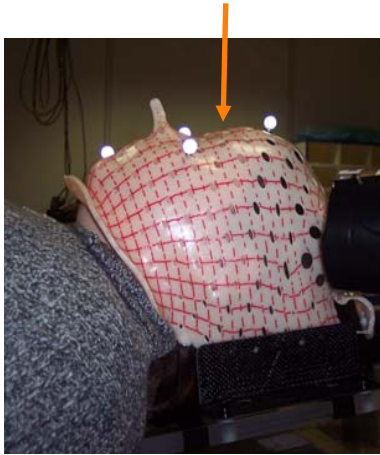
Ø8 mm reflective spheres

Provides a real time 6 DOF position of the target

Low cost system (~10000 €)

Immobilization devices

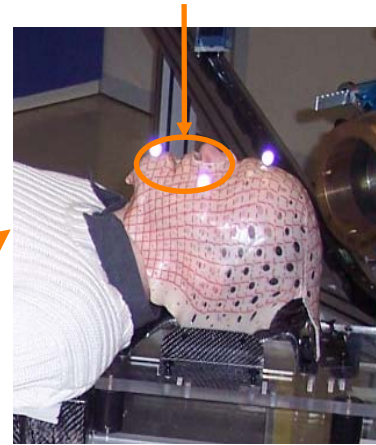
Polaris target



Thermoplastic mask

Repeatability :
translations -> 1.3mm
rotations -> 0.9°

Patient bites the mask



Thermoplastic mask

Repeatability :
translations -> 0.8mm
rotations -> 0.6°

Designed by PSI



Bite block system

Repeatability :
translations -> 0.7mm
rotations -> 0.5°



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III. Developed methods

EAGLE interface

Automatic calibration process

The screenshot shows the EAGLE software interface with the following sections:

- Identification Patient:** Contains fields for 'Salle', 'Numéro CPO' (07306), 'Num. Faisceau' (2), and 'Num. Masque' (11). A 'Fin' button is located below these fields.
- Corrections:** A table of correction values for X, Y, Z, W, P, and R axes.
- Informations Traitement:** Includes a status message 'Suite traitement : chargement dernière position!', a 'Validité dernière position' label, and a checkbox for 'SeancePrecedente'.
- Buttons:** Two large buttons, 'CORRIGE' (orange) and 'SURVEILLANCE' (pink), are positioned at the bottom right of the main interface area.

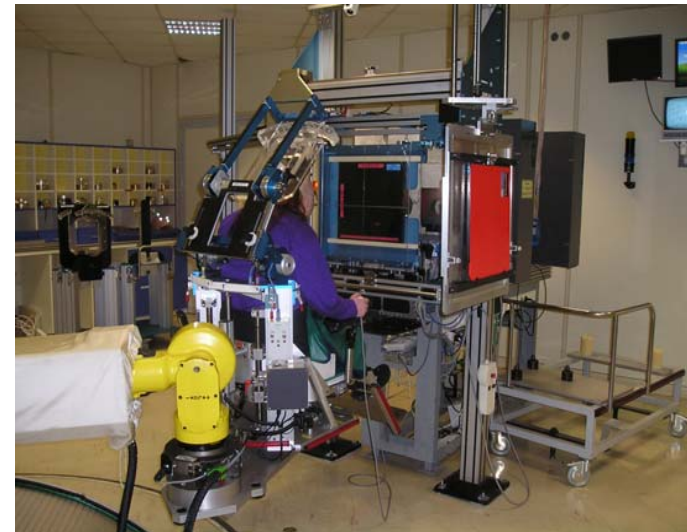
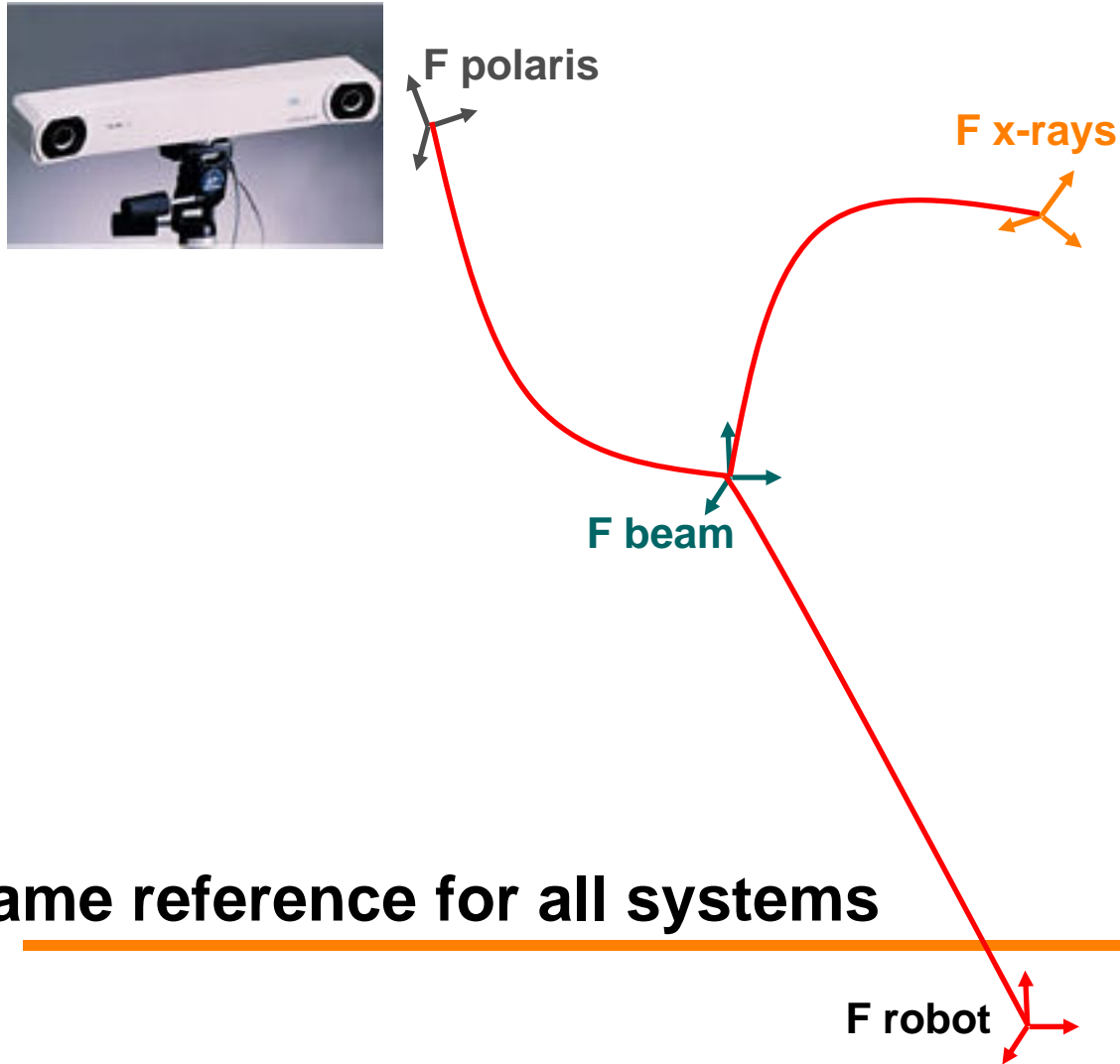
Axis	Value	Unit
X	0.86	mm
Y	1.60	mm
Z	-0.26	mm
W	-0.21	°
P	0.07	°
R	-0.13	°

Integrate the registration Algorithm and the automatic calibration algorithm

Link to TP

Automatic correction transfert to robot
Patient monitoring during irradiation

General room calibration



Same reference for all systems

CPO Modified positioning protocol

Daily process

1st field

- 1) Loading patient
- 2) Moving patient to recorded position
- 3) X Ray Validation
- 4) Eagle initialization

2nd field

- 5) Moving patient for 2nd field
- 6) Registration with EAGLE
- 7) X Ray Validation



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IV. Clinical results

Clinical results

- 20 patients have been positioned with EAGLE
- Only 10min for the 2nd field positioning
- Only one X-Rays exposure per field
- Must be tested with more patients to consider EAGLE as an alignment reference system

Clinical results

	P1	P2	P3	P4	P5	P6	P7	P8	P9
Runs	15	9	8	23	20	6	6	14	12
Success	13	5	5	20	10	5	4	12	10

- Total number of success, 84 for 113 runs (**success rate 74.3%**)
 - Success is when X-Rays validate the treatment position provided by EAGLE
-



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VI. Conclusions and prospects

Conclusions and prospects

- Immobilization devices have been improved (repeatability under 1mm)
- All positioning systems works in the same reference frame
- We expect soon only one X-rays check for all the session
- DICOM will soon be the standard for communication between systems

A large, faded, orange-tinted portrait of a man's face and shoulders, serving as a background for the slide.

Thank you for your attention.

Any questions ?