

# Artificial Intelligence for deterministic 2 players games with UCT

Pierre Gueth

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# Motivation

- Artificial intelligence
- PG camera
- Discrepancies between planned and actual configurations

## Aims

- Prediction of perturbation amplitude
- Study of correlation between PG profiles and perturbation components
  - Distal falloff position
  - Maximum correlation between profiles

# Context

## Granularity

- Whole treatment fraction ( $\sim 10^{10}$  protons for 2 Gy)
- Energy layer (constant energy,  $\sim 10^9$  protons for 2 Gy)
- Spot by spot monitoring ( $\sim 10^7$  protons for 2 Gy)

## Monitoring device

- Vertex imaging (inline, only for heavy projectiles)
- Prompt gamma camera (inline, proton and heavy projectiles)

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# PG monitoring technology

## Compton camera

- Compton interaction in scatter detector
- Emission position from line-cone intersection

## Knife edge

- Count hits of PG passing through a knife edge slit
- Easy geometrical reconstruction

## Multiple slits

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## Types of perturbation

- Patient position
- Patient orientation
- Stoichiometric calibration of TPS
- Tumor regression / anatomical change
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# Classifier training

- Find measure threshold by maximizing associated specificity and sensitivity (MASS)

$$\text{specificity} = \frac{\text{TN}}{\text{TN} + \text{FP}}$$

$$\text{sensitivity} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

$$\text{MASS} = \max_{MT} \sqrt{\text{specificity}^2 + \text{sensitivity}^2}$$

- Upper-left most point in ROC curves

# Classifier training

# C++ implementation

```
class Board {  
public:  
    virtual ~Board() =0;  
  
    virtual Board *deepcopy() const =0;  
    virtual Move *parse_move_string(Token player, const char *string) const =0;  
    virtual void print() const =0;  
    virtual bool is_move_valid(const Move &move) const =0;  
    virtual Moves get_possible_moves(Token player) const =0;  
    virtual void play_move(const Move &move) =0;  
    virtual bool play_random_move(Token player) =0;  
    virtual Token check_for_win() const =0;  
    virtual Token play_random_game(Token next_player);  
};
```



Demonstation  
Can you beat the IA ?

Thanks for your attention

## Pierre Gueth

### Wide technical and academical knowledge

- Classe préparatoire PT
- ENS Cachan  
aggrégation physique appliquée / EEA
- Thèse au laboratoire CREATIS (Université Lyon I)  
Imagerie médicale ultrasonore  
Estimation de mouvement
- Post doc au Centre Léon Bérard (Lyon)  
Simulation Monte-Carlo Protonthérapie (GATE)  
Imagerie  $\gamma$ -prompt

### Numerous computer side project

- Freesiege, Blocks, ...
- UCT
- Autojump, cluster submission tools