

Deep learning algorithm to predict Greulich and Pyle bone age

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ESPR

European Society of
Paediatric Radiology

Conflicts of interest

Consulting missions for Gleamer

Why develop AI in bone age assessment ?

Problems of GP bone age

Old data

Inter-individual variations

Depends on the ethnicity

Evolution +++ of the bone age

Subjective interpretation : inter and intraobserver
variability

Time consuming

Automated Pediatric Bone Age calculation with



PEDIATRIC BONE AGE

- Automatic processing
- Frontal Hand acquisition
- Patients 3 – 18 y.o.
- trained on 12,600 images
- validated on 1,000 images
- tested on 200 images



| | |
|---------------------------------|--|
| CHRONOLOGICAL AGE | 14 years 3 months |
| AI-BASED GREULICH & PYLE (MALE) | 12 years 7 months |
| SD* = 10.72 months | → 2 SD = [12 years 6 months ; 16 years 5 months] |

*Standard deviation [Greulich WW, Pyle SI, 1959]

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Material and methods

DATA COLLECTION

- Frontal right and left hand X-rays
 - 5 to 17 years old
 - 8 boys, 8 girls per age
- => 206 X-rays (2 excluded)**

GOLD STANDARD

- Independent assessment of GP bone age by 2 senior pediatric radiologists
- With access to chronological age and sex
- Ground truth defined as the mean of the two estimations

READING

- Independent analysis of the dataset by a general senior radiologist
 - With access to chronological age and sex
 - Blinded to the AI results
- => Comparison between the results of the reader and the AI**

Performances of the AI vs. the radiologist

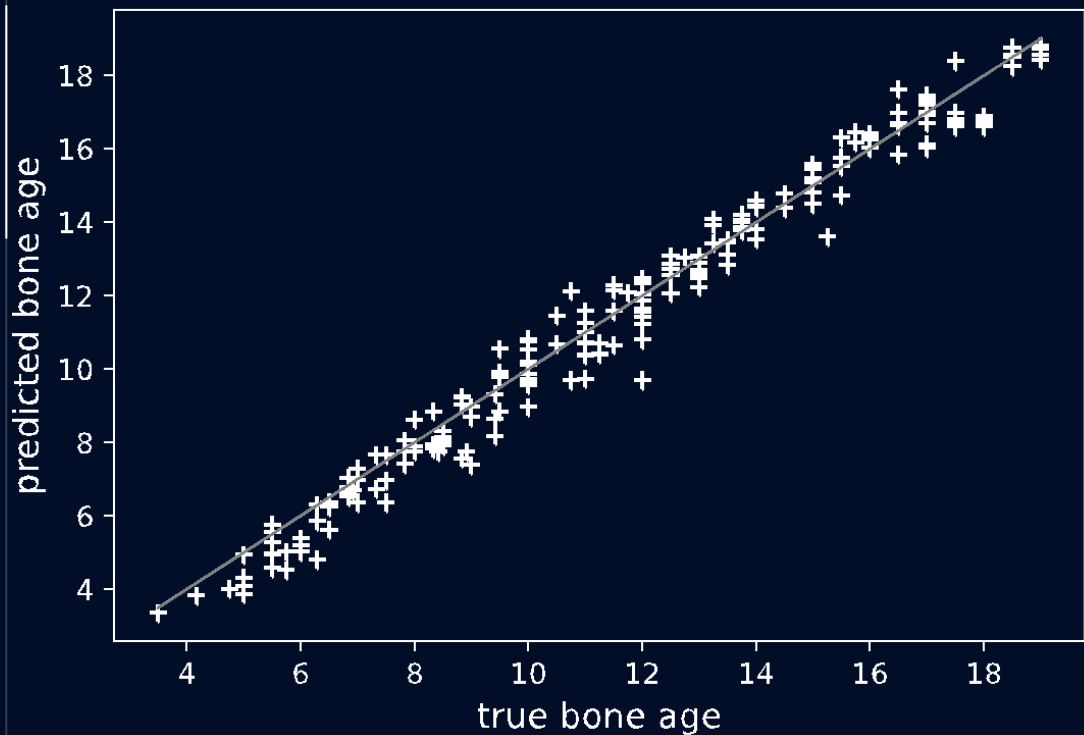
- Inter-observer variability (gold standard) : average of 6 months difference

Mean absolute error

| | AI BoneView | General radiologist |
|-------|-------------|---------------------|
| Boys | 0.488 | 0.77 |
| Girls | 0.494 | 0.673 |
| All | 0.491 | 0.721 |

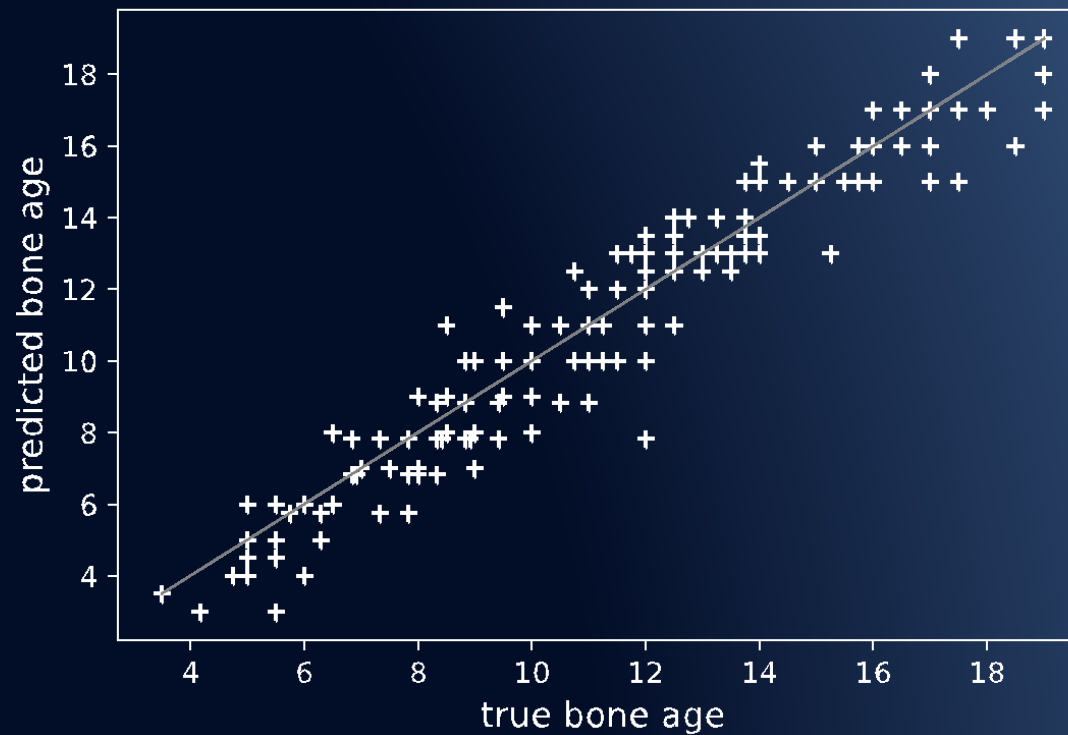
Correlation plots

AI



Correlation coefficient : R2 = 0.976

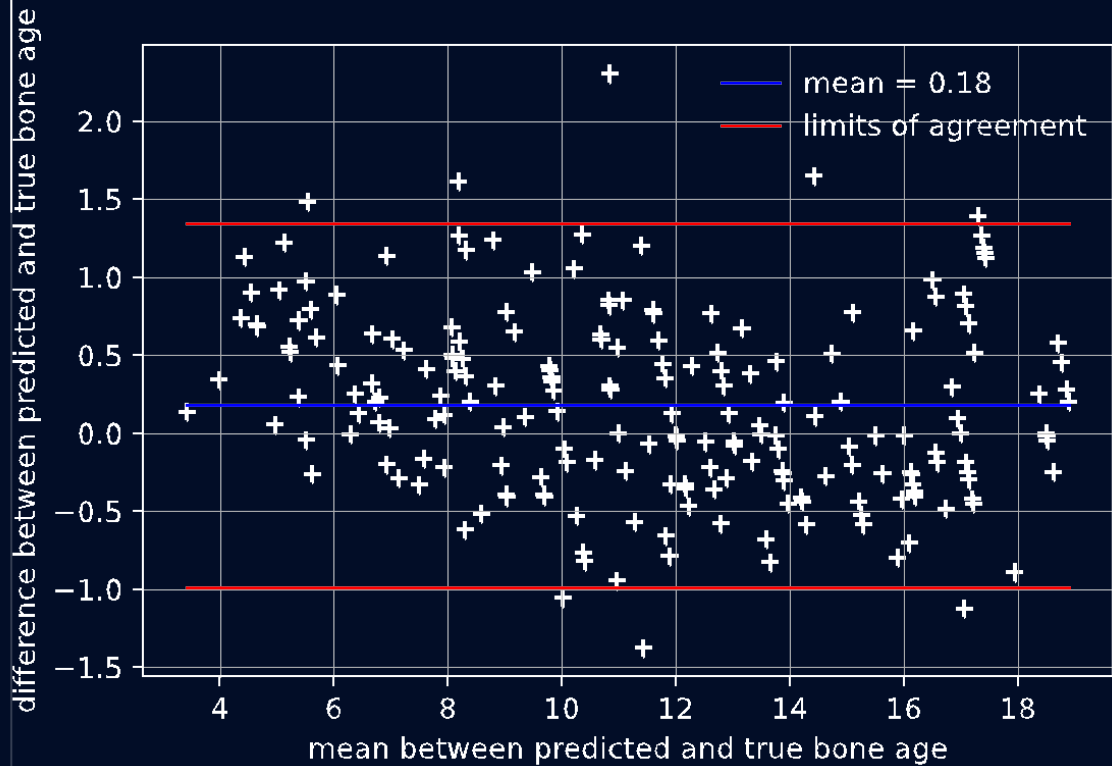
General radiologist



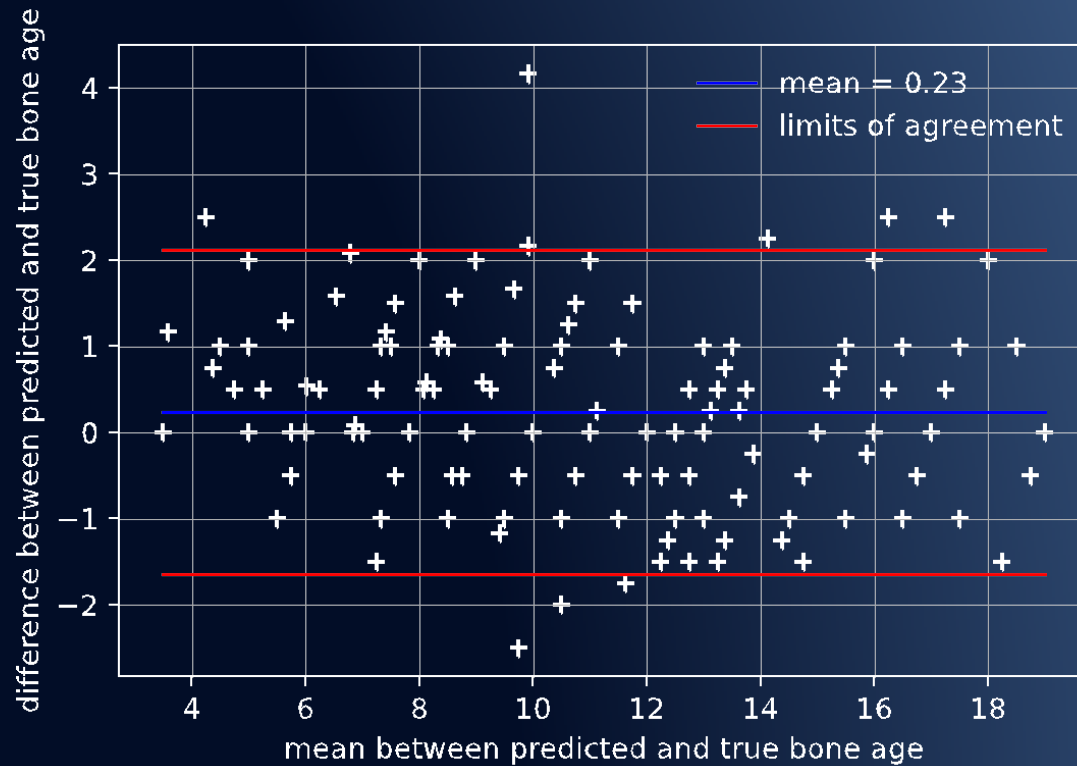
Correlation coefficient : R2 = 0.938

Bland-Altman plots

AI



General radiologist



Discrepancies between AI and gold standard

14 years old boy



| | Age | Results according to 2SD* |
|---------------------|-------|---------------------------|
| Gold standard | 15.75 | normal |
| General radiologist | 15 | normal |
| AI BoneView | 16.2 | advanced |

Difference of 0.45 years

Discrepancies between radiologist and gold standard

9 years old girl



| | Age | Results according to 2SD* |
|---------------------|------|---------------------------|
| Gold standard | 11 | advanced |
| General radiologist | 8.83 | normal |
| AI BoneView | 11.2 | advanced |

Difference of
2.17 years

Conclusion and outlook

- Potential of reduction in interpretation and report time

| | | | | | |
|--------|-----------------------|-----|---------------------|-------|----------|
| 1mn30s | Pediatric radiologist | 3mn | General radiologist | < 1mn | BoneView |
|--------|-----------------------|-----|---------------------|-------|----------|

- High accuracy
- Possible further studies
 - Time reduction
 - Inter and intraobserver variability



Thank you

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