Thesis CIFRE Proposal

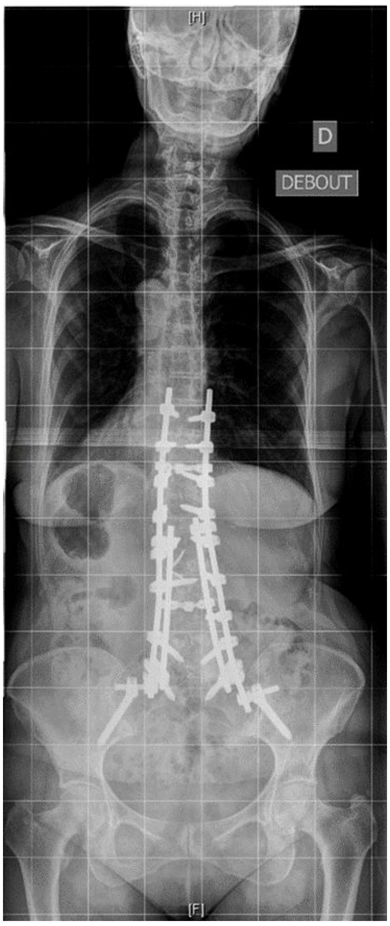
Biomechanics-Orthopedics

Development of a "patient specific" Finite Element Model of the spine to assist surgical correction planning in severe scoliosis and adult spinal deformity.

Domain	Orthopaedics, Mechanics, Numerical simulation, Optimization, Database,
Start of Thesis	September-October 2023
Workplace	Strasbourg University/ Manufacture des Tabacs
Laboratory	ICUBE Team MMB
Industry	Clariance
Type of contract	CDD-CIFRE (3 years)

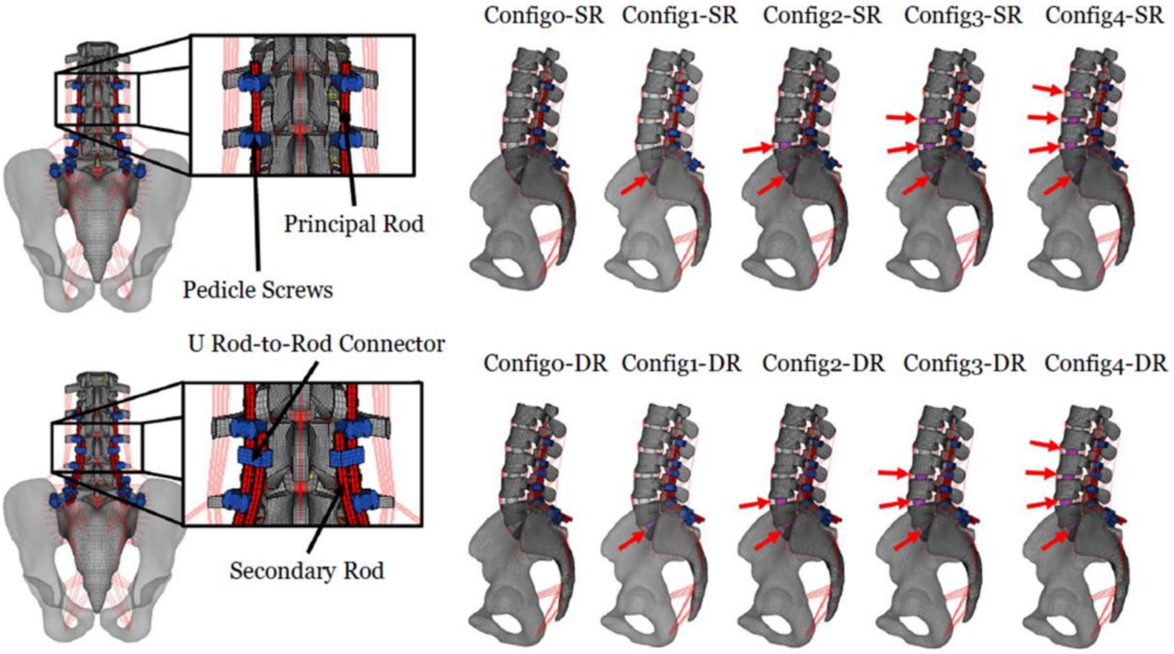
Contact: **frmeyer@unistra.fr (CV, cursus scores)**

https://icube.unistra.fr



Context: Surgical corrections of degenerative lumbar scoliosis and sagittal malalignment are associated with significant complications, such as rod fractures and pseudarthrosis, particularly in the lumbosacral junction. To understand the mechanism involved in this degeneration a first interaction between the Department of Spine Surgery, University Hospital of Strasbourg (HUS the MMB team-ICUBE Laboratory) specialized in biomechanics was done. A whole spine Finite Element Model based on healthy 50th percentile male was developed and validated against data available in the literature. Different implant configurations surgical instrumentation techniques were simulated with the FEM and evaluated in terms of robustness under uniaxial loadings. The first results were in accordance with the clinical observation.

Objectives: There is a need to develop "patient specific model" to improve preoperative planning by taking variability of normal spino-pelvic shapes into account. Based on a database of 2599 normal individuals available at the HUS a new classification of the spine shape will be defined. Multi-center studies were conducted to describe the parameters of sagittal alignment as a function of age and pelvic incidence. This reference system could be applied to the existing MEF to move towards a more discriminating analysis adapted to the patient's preoperative situation. The second objective of this thesis is to characterize dynamic conditions such as walk, and to apply these boundary conditions to the "instrumented FEM". This type of loading will be more realistic compared to the uniaxial conditions done in the previous research.



Leszczynski A., Meyer F., Charles Y.P., Deck C., Willinger R. (2022) Influence of double rods and interbody cages on range of motion and rod stress after spinopelvic instrumentation. A finite element study. Accepted in European Spine Journal.