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Customer References

Custom-made hip prosthesis STEM reconstruction with Mathcad and Creo Parametric Essentials

Ing. Massimo Arcolin

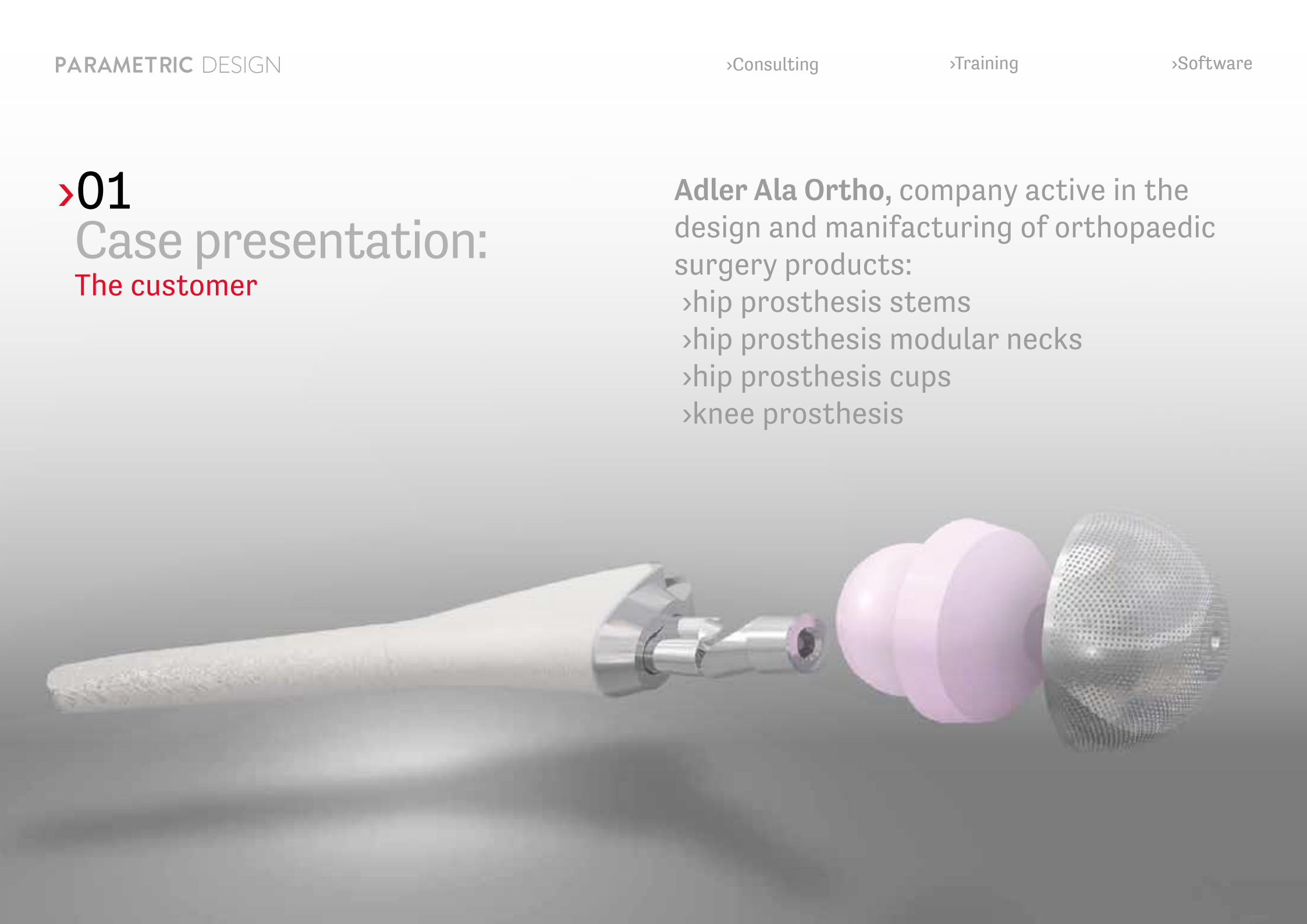
Index

›01 Case presentation:

The customer

Adler Ala Ortho, company active in the design and manifacturing of orthopaedic surgery products:

- ›hip prosthesis stems
- ›hip prosthesis modular necks
- ›hip prosthesis cups
- ›knee prosthesis



›01
Case presentation:
The product

Customized hip prosthesis stem, a solution used in the field of total hip replacement, for example when standard hip implant can’t be suitable to the patient´s femur

Anatomical features of the human skeletomuscular system are taken into account in the designs of custom hip implants, enhancing load transfer from the implant to bone

›01 Case presentation:

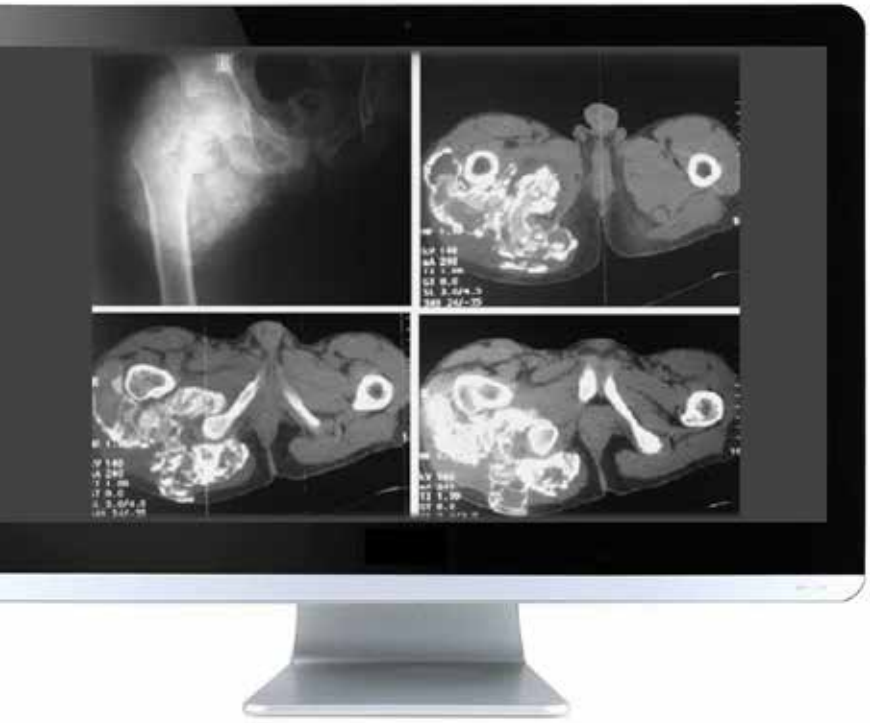
The work purpose

›Creo Parametric Essentials
›Creo AAX (Advanced Assembly Extension)
›Creo BMX (Behavioral Modeling Extension)
›Mathcad

Development of a methodology able to automate the realization of a 3D model of the hip prosthesis stem, custom-made according to computer tomography images (CAT scan)

Employment of Mathcad mathematical features to process input data and dynamically control the output geometry, taking advantage of Creo Parametric Essentials integration

›02
Input data to reconstruction: polylines iges



CAT scan images

›

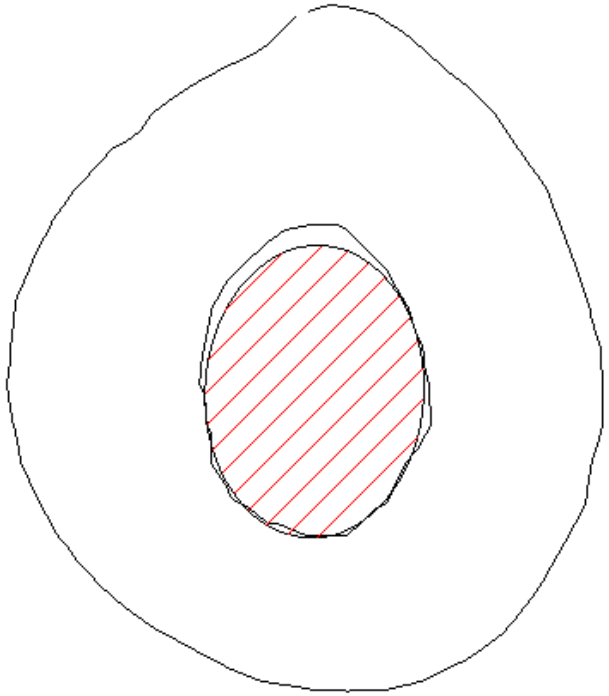
Medical image processing software

Polylines representing the hipbone sections outline, exported with iges format

›03
Hip prosthesis stem geometry: required features

The final stem geometry has to be designed so that:
the prosthesis section fits exactly into the femoral cavity in the hipbone distal portion

the prosthesis section fits the medial and front sides of the femoral cavity, while diverges from lateral and rear sides in the hipbone proximal portion



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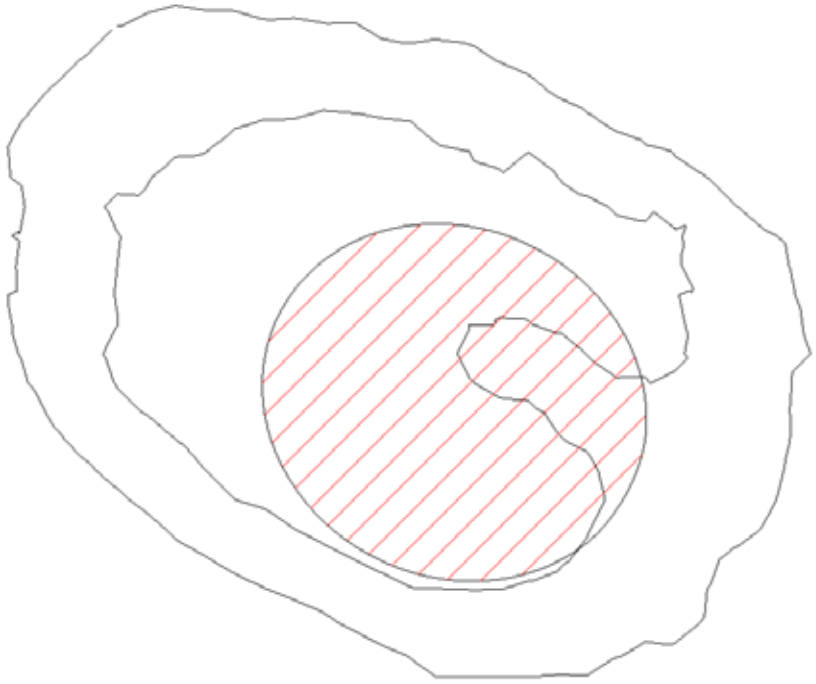


›04
Reconstruction methodology: flow chart

›04 Reconstruction methodology: flow chart

Input Data › Mathcad data processing › Esporting data from Mathcad › 3D model realization

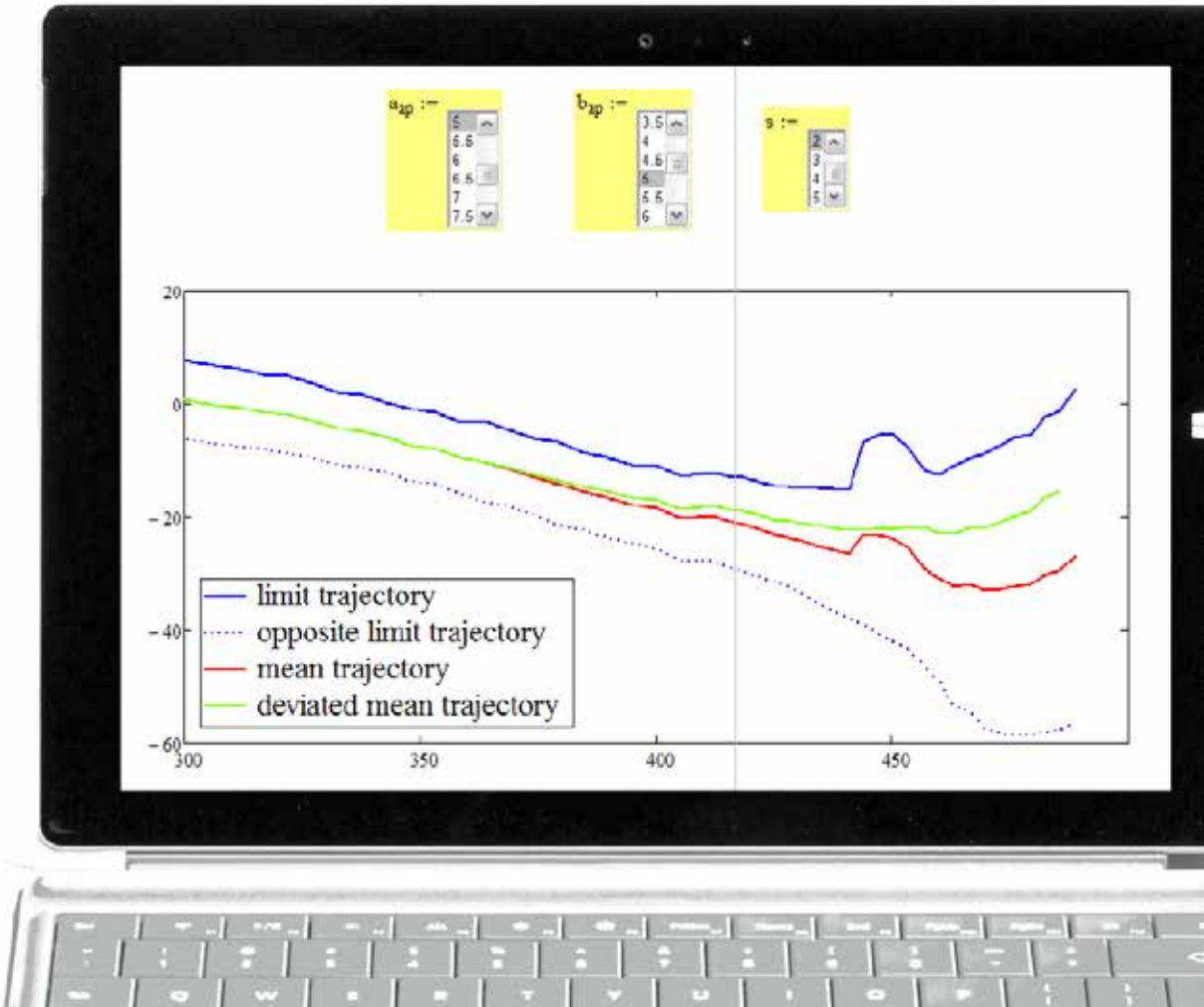
Iges format file, containing 3D coordinates of points forming polylines sections

›04 Reconstruction methodology: flow chart

›Importing iges data
›Cleaning data and filtering outer sections
›Calculating coordinates of points forming:
  ›limit trajectories of the femoral cavity on front-rear and medial-lateral planes
  ›mean trajectories on the 2 planes
›Mean trajectories deviation: correction driven by user introduced parameters
›Smoothing curves

›04
Reconstruction methodology: flow chart

Data input › **Mathcad data processing** › Esporting data from Mathcad › 3D model realization



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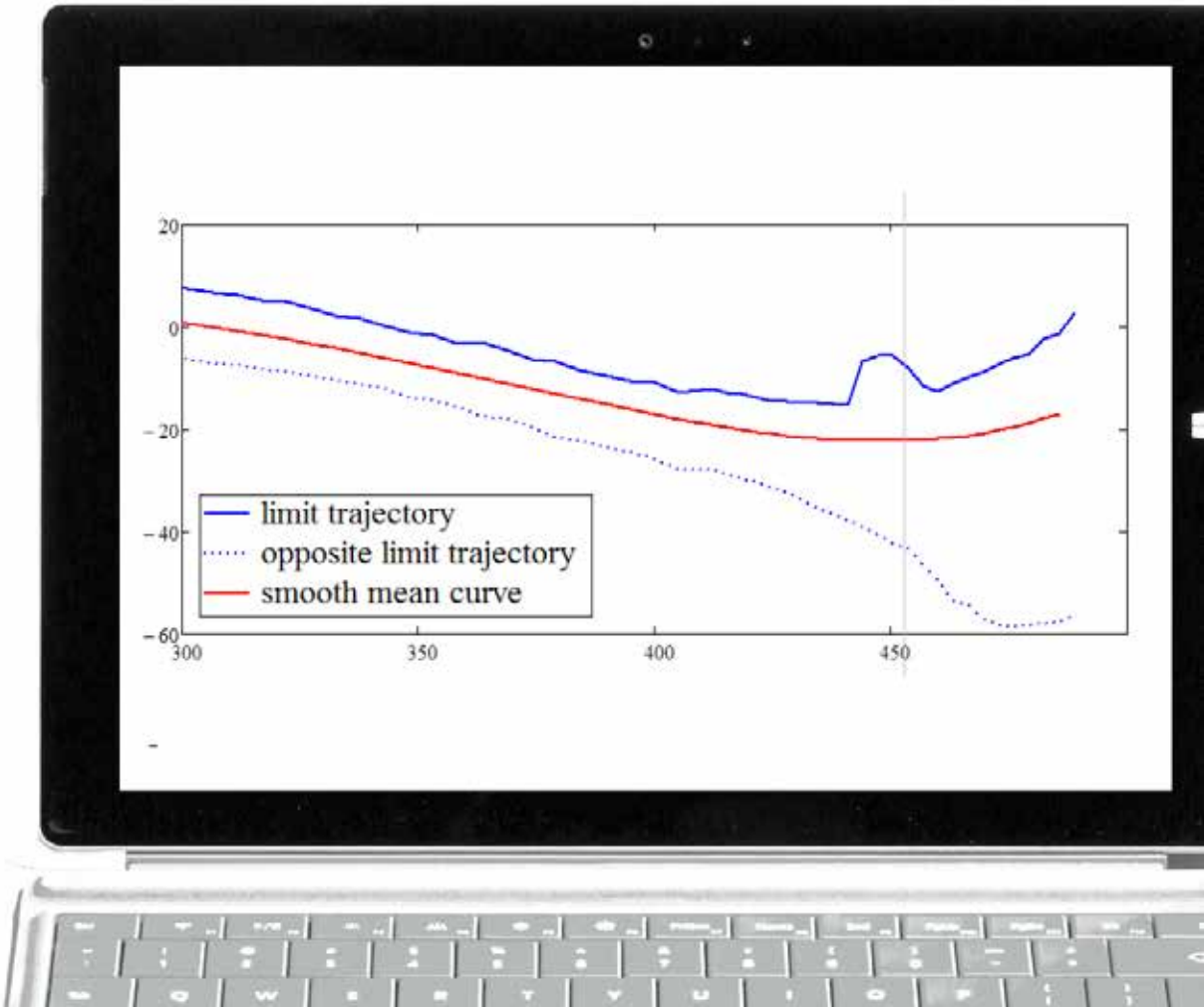


›04 Reconstruction methodology: flow chart

Data input › Mathcad data processing › **Esporting data from Mathcad** › 3D model realization

Text file writing, containing 3D coordinates of points forming calculated trajectories, in order to reconstruct the stem geometry in Creo Parametric Essentials

›04
Reconstruction methodology: flow chart

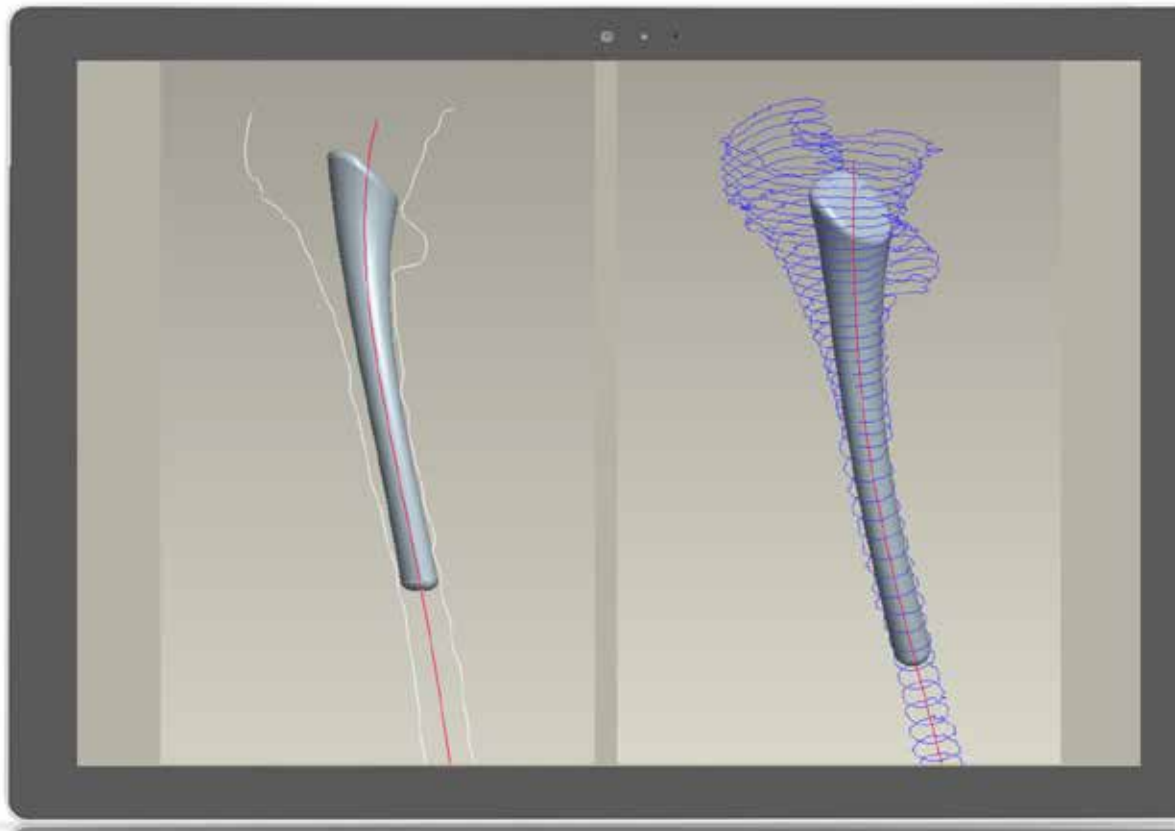
Data input › Mathcad data processing › Esporting data from Mathcad › 3D model realization

Creating 3D curves in Pro/Engineer, driven by Mathcad generated files, that represent trajectories piloting stem geometry

Modeling the final geometry taking advantage of Creo Parametric Essentials BMX Extention features

›04
Reconstruction methodology: flow chart

Data input › Mathcad data processing › Esporting data from Mathcad › 3D model realization



›05
Analysis features with Creo BMX (Behavioral Modeling Extension)

Modeling the final geometry taking advantage of
Creo Parametric Essentials BMX Extention features

›06 Conclusions

The strong point of the implemented methodology is to allow a fast and easy updating of the hip prothesis geometry, across the following phases:

›Updating the input data (iges file of a new femur)
›Recalculating the Mathcad, spreadsheet, with resulting updating of output files
›Updating the trajectories in Creo Parametric Essentials - driven by such files - and consequently the entire model of the custom-made hip prosthesis stem

User introduced parameters allow an easy control of the reconstruction procedure, with dynamic updating of trajectories simulating the final geometry in the Mathcad spreadsheet

Thank you!

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ADVISOR

Italian Operating Offices
Parametric Design S.r.l.
Piazza Corte Grande 24/25
20060 Gessate (MI)
+39 02 95384199
+39 02 95382708

info@parametricdesign.it

Swiss Operating Offices
Parametric Design Suisse Sagl
Corso San Gottardo 24
6830 Chiasso (Ch)

+41 91 945 31 40

info@parametricdesign.ch