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ADVISOR

Customer References

Design of a cylinder for winding thread guide

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›01 Job description

The client

Leader Company in the production and commercialization of finishing machines for wool, cotton, linen, silk and synthetic threads:

- ›automatic spooler rockers
- ›double-torsion twisting machinery
- ›electronic couplers
- ›spoolers for continuous thickening and retraction
- ›open-end rotor thread spinners

›01 Job description
The product

A metal cylinder reel is the hub of an automatic spooler, a machine that guarantees the processes of ordinate and weave at very high speeds, exploiting electronic modulation and tension control of the winding

The rotation of the cylinder moves the reel on which the thread, guided by the grooves, is helically wound

›01
Job description
The objective

›Creo Parametric Essentials
›Creo AAX (Advanced Assembly Extension), Creo Simulation
›Creo BMX (Behavioral Modeling Extension),
Creo MDO (Mechanism Dynamics Option),
› Creo REX (Reverse Engineering Extension)
›Creo Complete Machining (CAM)
›Scilab (Applicazione Matematica Open Source)

Development of a method capable of furnishing solid-form modelling of the surface of the cylinder's helical groove in Creo Parametric Essential, along with the CAM track of the instrument employed to create the actual geometry

›

Optimization of the design process for new geometries of the helical groove, with the possibility to execute suitable variations while carrying out real-time evaluation of the effects

›02
Helical grooving of the cylinder: movement of the mill cutter

The thread-guiding groove of the cylinder is designed to prevent the thread from crossing over on the reel and causing undesired changes of thickness in the spool

pass, depth and geometry of the section of the helicoid change along the cylinder axis

the section of the helix has a characteristic “drop-like” oval profile

›02 Helical grooving of the cylinder: movement of the mill cutter

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The helicoidal groove is fisically realized through a mill cutter manufacture, driven by a numerical control machine with 5 axes

›02
Helical grooving of the cylinder: movement of the mill cutter

5 movements of the mill cutter:

›rotation around the cylinder (θ)
›advancement along the axis (z)
›depth of cut on the cylinder (r)
›helix angle (α)
›opening angle (β)

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›02
Helical grooving of the cylinder: movement of the mill cutter

independent movements, described by graphs in function of the angular coordinate θ

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›02 Helical grooving of the cylinder: movement of the mill cutter

movement determined by the advancement along the axes executed during an angular advancement: $\tan \alpha = \frac{\Delta z}{\Delta (r\theta)}$

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›03 The problems of modelling a groove in Creo Parametric Essentials

Reproduction of mill cutter movements

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›03
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Reproduction of mill cutter movements

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The final geometry of the groove is unequivocally determined by the mill cutter profile and the 3 graphs that pilot the movement

The groove is the result of an ideal boolean subtraction from the cylinder of the space occupied by the bit during its movement

›03
The problems of modelling a groove in Creo Parametric Essentials

Reproduction of mill cutter movements

›importing the movement graphs into Creo Parametric Essentials

›reading the graphs with the “evalgraph“ function

›sampling graphs to correctly position the coordinate-systems at fixed angular di-stances

›assembly of the mill cutter model on the coordinate-systems to reconstruct the movement of the mill cutter around the cylinder

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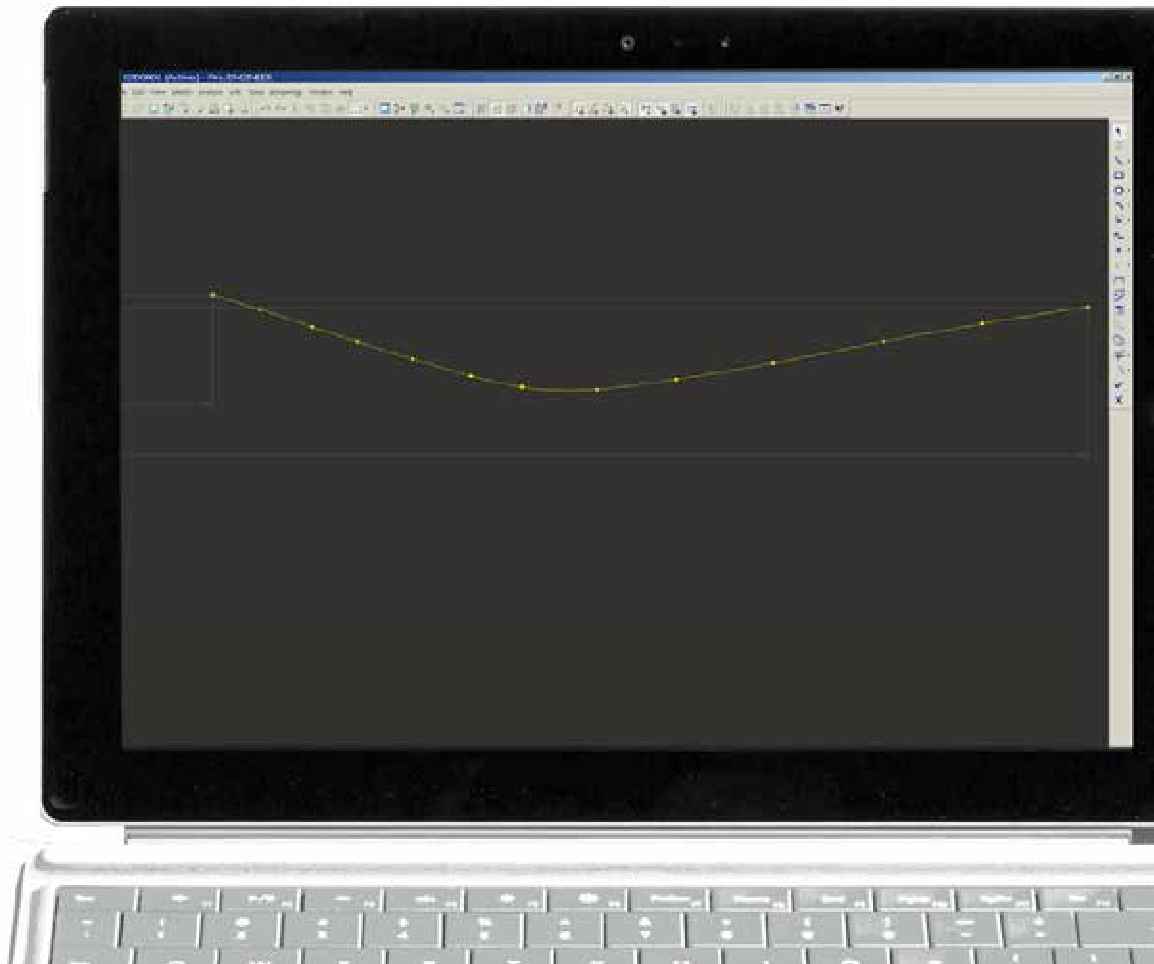
Reproduction of mill cutter movements



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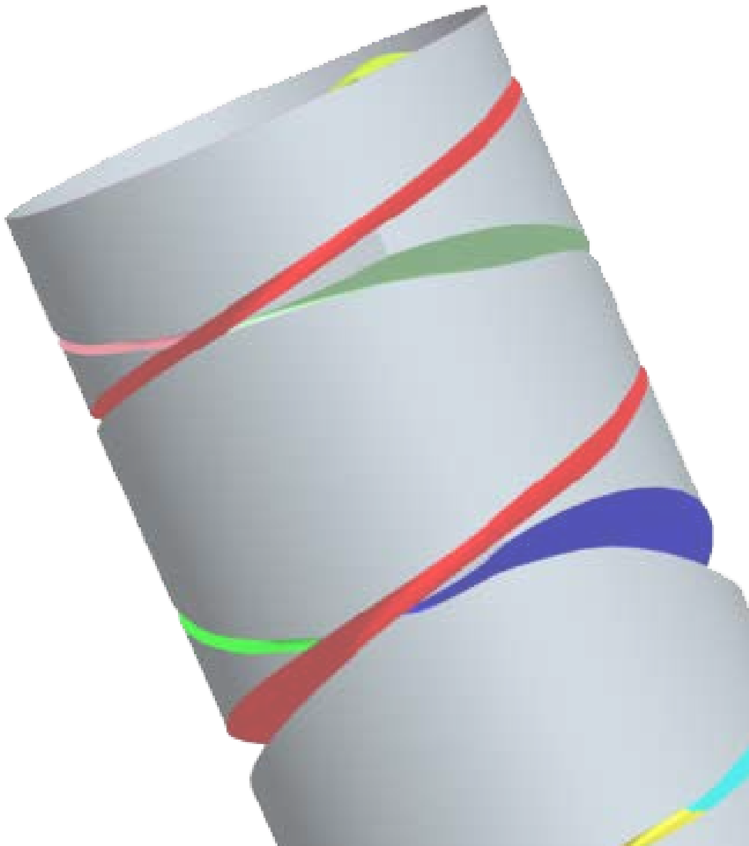
›03
The problems of modelling a groove in Creo Parametric Essentials
Creating the surface - first method

›exporting in STL format the space occupied by the mill cutter bits (a tessellated surface is obtained, not readable in CAM)

›smoothing technique that restores a smooth enveloped surface (using the **REX Reverse Engineering Extension Module**)

›employment of the obtained milling surfaces to reconstruct the external part of the cylinder



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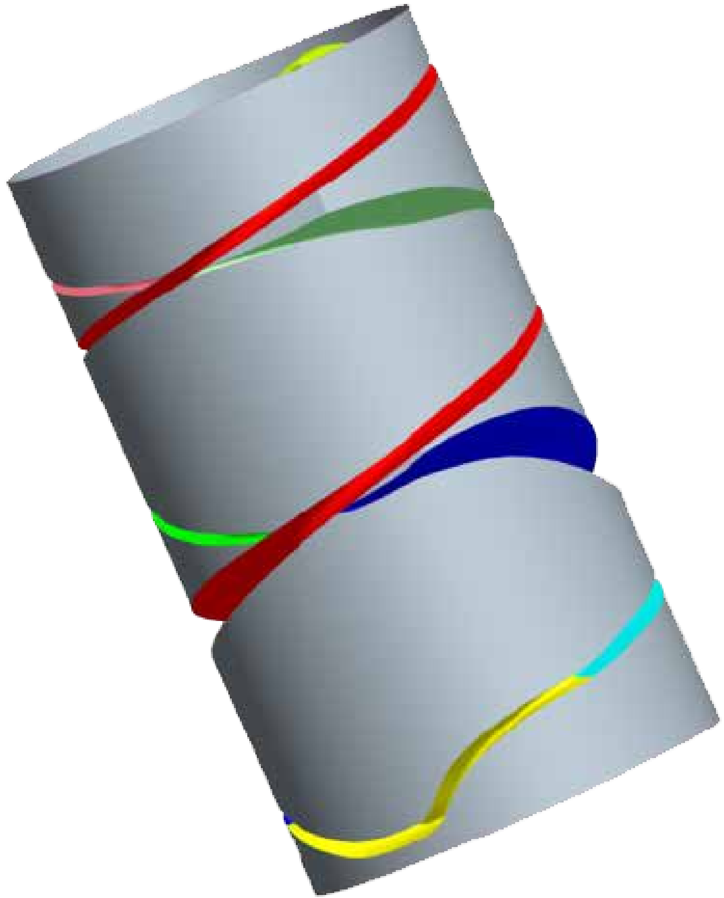


›03
The problems of modelling a groove in Creo Parametric Essentials
Creating the surface - second method

A program has been implemented that uses Scilab as calculation software to reconstruct, associatively, the groove surfaces

The program receives in input:
›control graphs of the mill cutter path
›geometries of the cylinder and the mill cutter bit
›values of some correction-parameters necessary to control the results

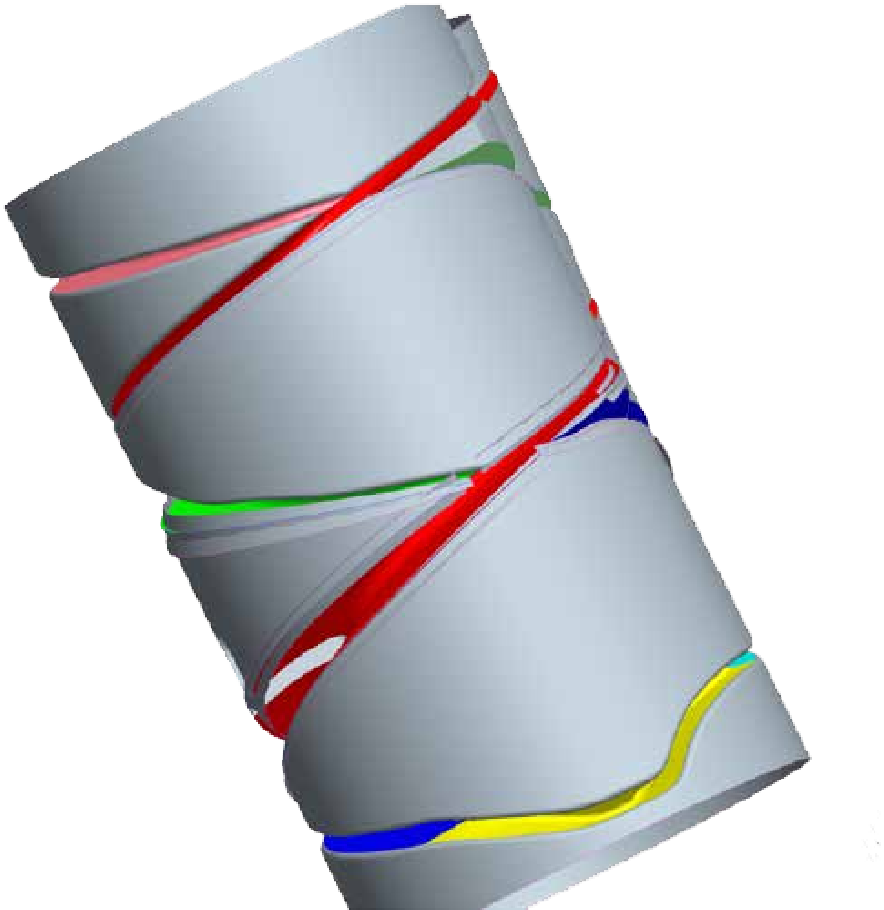
Returns as output:
›file .ibl which, read by Creo Parametric Essentials, permits the associative reconstruction of the helical groove geometry

›04
Creation of the finished cylinder

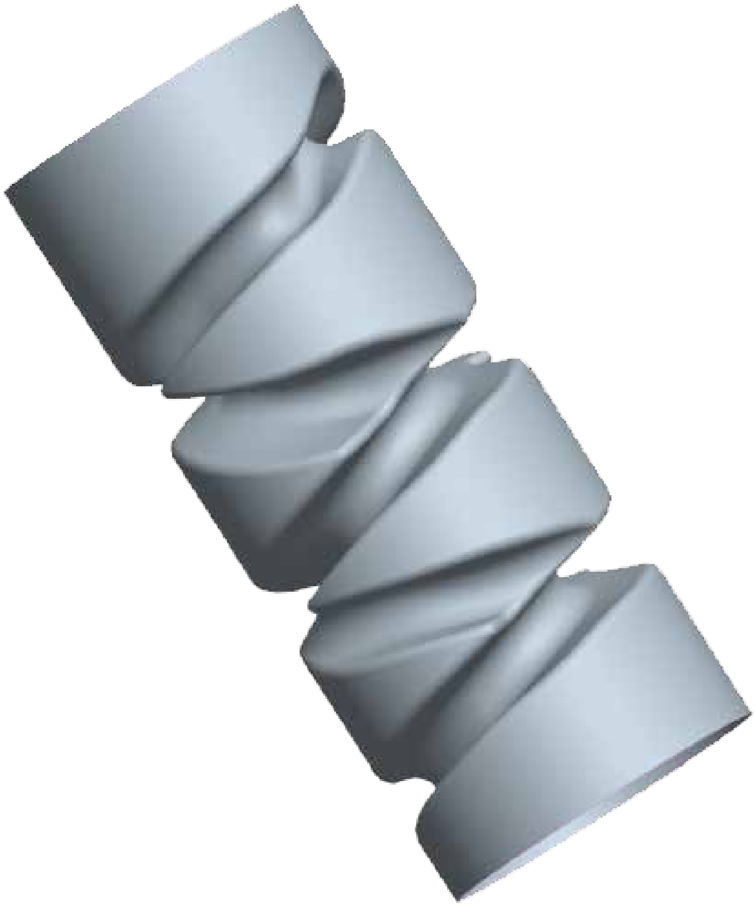
- ›Modelling the last features of the cylinder (ISDX module)
  - ›vertex milling
  - ›cords milling
  - ›coursing lines
  - ›radius
- ›Realizing the internal parts of the cylinder
- ›Checking sectors extraction with draft analysis
- ›Dynamic balancing (MDO and BMX modules)
- ›Passing the model in CAM environment to create a program of post- processing

›04
Creation of the finished cylinder

›Finished cylinder



›Internal part



›05
Notes on the balancing process

Dynamic balancing of the cylinder is obtained creating internal ribs and employing optimization analysis with the BMX module of Creo Parametric Essentials

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›Rotation of the cylinder at 600 revs/min

›Minimization of the radial moment M and the radial reaction force R

›Result: M = 5 Nmm ; R = 0.1N

›06 Conclusions

Advantages introduced by employment of the described procedure are multiple:

- Optimization of the procedure for the design of new geometries, thanks to the interactive modification of the movement charts with instant updating of the mill cutter track and the resulting final groove
- Employment of correction-parameters, that allow the regulation of the mill cutter movements and conseguently control the obtained result in the 3D model
- Simultaneity of results, that is, obtaining the groove geometry and the CAM track that effectively creates it
- Elimination of adjustment actions, previously necessary for the finishing features not obtainable on the machine
- Perfect repeatability and interchangeability of every model created

Thank you!

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