Computer Aided Manufacturing 2019-2020

Group Project Instructions

1. Purpose

The group project consists in a homework assigned to a group of students (5 persons per group), in which the group has to solve two engineering problems, related with computer manufacturing:

1. Manufacturing.
2. Inspection.

In the first part of the project, the groups will have to design a (realistic) complete workcycle using the CAD/CAM approach. In the second part of the project, the groups will design the inspection of the part by using a CMM.

2. Manufacturing Project

Each group is asked to provide a complete CAM design of the part to be studied. The CAM workcycle should be designed using CATIA and saved in .CATProcess format. The group should provide also a report document, organized as follows:

a. Cover (group details).
b. Machining features identification.
c. Definition of the machining operations.
d. Setup definition and part fixturing,

In Section "Machining features identification", the group is expected to identify and describe, for each one of the given parts, a complete list of the machining features that need to be realized.

In Section "Definition of machining operations", the group should provide a complete list of all the machining operations, containing a reference to the machining feature. For each machining operation, the group should report also:

- Details of cutting tool used (producer, picture of the tool, suggested cutting parameters).
- Corresponding cutting parameters (feed rate, spindle speed, a_p and a_e).
- Estimation of machine tool power consumption.
- Estimation of machining time.

In Section "Setup definition", the group is asked to determine the number of setups required to machine the given part, assuming the introduction of the part fixturing. The group is asked to modify the machining features previously identified accordingly. These setups should be created using CATIA assembled products, and saved as .CATProduct files.

2.1. Part details

- Part to manufacture: ISO 10791-7:1998, large version.
- Material: aluminum.
- Stock: aluminum AISI 2014 block 330x330x90 mm.
- All faces should be machined.
- Machine: MCM Clock 1200
    - X, Y, Z axes + rotary table.
    - Spindle: HSK63.
    - Max power: 36 kW
    - Max speed: 30.000 rpm
- Tool manufacturer: Mitsubishi Carbide.

2.2. Manufacturing Project Deliverables recap

Each group should prepare:

- 1 PDF document with the report.
- 1 compressed archive with all CATIA files.

3. Inspection project

The groups will describe the procedure for the inspection of the part described ISO 10791-7:1998, large version on a CMM. This requires the following steps:

- suggest an adequate positioning and fixturing;
- propose an adequate CMM and probe;
    - The selected CMM for the project is a Zeiss Prismo navigator 5 HTG with VAST Gold probing head. Brochures can be found at: https://beep.metid.polimi.it/documents/167385808/45d2730a-f936-4c8e-aefa-81405400430e https://beep.metid.polimi.it/documents/167385808/2e7df059-1b1e-4c50-aa93-a9c7b50ef08f
- define the probe configuration (stylus length, tip diameter etc.);
    - A catalogue for the styli can be found at: https://shop.metrology.zeiss.com/
- choose the mathematical alignment;
- plan the measurement strategy (number and location of sampling points, probe path, probing sequence, etc.);
- in case any tolerance will not be inspected, motivate the reason for the exclusion.

For a single geometric tolerance, the students will have to estimate the measurement uncertainty provided by the chosen strategy by simulation, and state whether this uncertainty is adequate or not to verify the conformance to the tolerance itself. The selected tolerance is the perpendicularity tolerance of the central hole to datum plane A. A MATLAB reference feature generator can be found at:
https://beep.metid.polimi.it/documents/167385808/2a1785c7-8135-426e-92a8-97e8c0ce5f8f

3.1. Inspection Project Deliverables recap

Each group should prepare:

- 1 PDF document with the report.
- 1 compressed (.zip or .7z) archive with all source MATLAB script, data and function files developed. They should be organized such that running a “main.m” script starts the simulation and evaluates the uncertainty.

Table 1: Process Plan Reporting

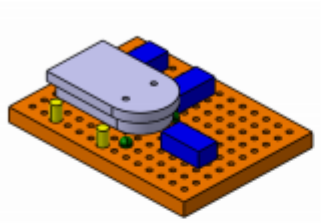
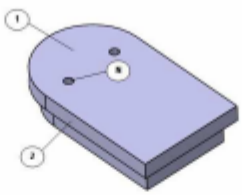
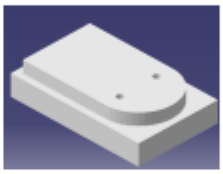
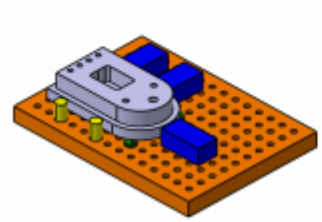
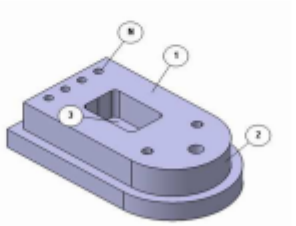
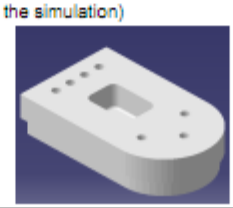
Phase	Position (Fixturing Assembly)	Machined features	Operation sequences	Tool (mill/drill)
1	- Pictures of the assembly 1 	- Pictures of the part  - Pictures of the resulted part (Saved from the simulation) 	1. Facing 2. Contouring N. drilling	tool 1 tool 2 tool N
...	...	...	...	...
N	- Pictures of the assembly N 	- Pictures of the part  - Pictures of the resulted part (Saved from the simulation) 	1. Facing 2. Contouring 3. pocketting N. drilling	tool 1 tool 2 tool 3 tool N

Table 2: Operation Details

No.	Features	Phase	Tool type	Tool data					a_p	a_e	V_c	n	V_f	K_c	P_c	OK/NO
				D	l1	max ap	max ae	...								
1	Facing	1	face mill	5	1	1	1	...	0.5	1	20	100	2	1500	100	OK
...																
No.																