New Metro Challenge

Aim of the challenge

The purpose of the challenge is to create an opportunity of international learning and project work for students/learners who took part in 2021/2022 in the New Metro Validation and Piloting Phases.

It requires the collaboration and active involvement of all training bodies which took part in these phases through the provision of tutorial support and the participation in the learning experience design and coordination.

The New Metro Challenge should:

- Allow to test a set of the competences as described by the New Metro Framework
- Allow to observe transversal competences/soft skills also identified in the New Metro Framework
- Enable the development of inter-cultural skills applied to specific collaborative work
- Be based on the work of groups of students from 3 to 5 project Countries (ideally two students per each training body)
- Enable each transnational group to work through digital sessions, while students from the same class will have access to the necessary equipment locally
- Organise Transnational Groups to work in parallel on the same or similar problems/challenges
- Allow not only to achieve a correct result, but stimulate initiative of students to propose original and well performing solutions to the problem proposed

Theme of the Challenge

Concept obtv

The Challenge project has to stimulate students or users of the simulation system that from now on will be defined NEW METRO challengers to follow a challenging and engaging course at the same time.

Reason Why

Through participation in the solution of an operational project, the teams of challengers will be able to compete with colleagues from Countries participating in the NEW METRO project work with equal opportunities

It is an advanced learning method, structured and at the same time allows with proactive activity to lead innovative techniques

In other words, an operational Learning-By-Doing methodology that expands the panorama of possible comparisons and parameterizes the distributed level of knowledge demonstrate and acquired

A competitive benchmark with a borderless vision in order to meet the best EU spirit

In addition, the results of a learning process in the field will be available in this way.

The evaluation process will be implemented by a commission of experts both of a technical nature and of the teaching staff.

Operating modes

Concept process automation 4.0 design of an automatic machine

Wiring diagram

Software diagram

Operational constraints and

SWOT analysis

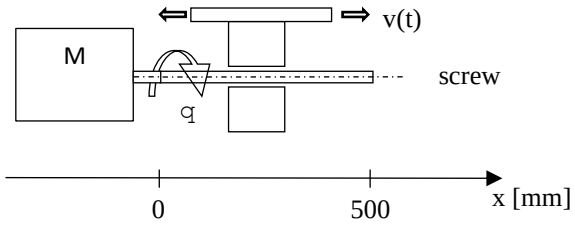
CHALLENGE PROCESS

DESIGN OF A CONTROLLED LINEAR SYSTEM

Introduction

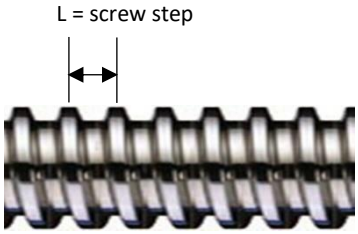
A linear screw/screw system allows to transform the rotary motion of the screw into the translational motion of the mother screw (snail).

In ball screws between the two parts, a series of rolling bodies (balls) is interposed in order to reduce friction.



q = angle

w = angular speed



Objectives of the project

The designer, having made any additional assumptions that he deems necessary (*), realizes a prototype of the system following the following steps:

1. Calculate the torque required of the motor to achieve the direct drive system (rotary to linear)

2. Calculate the power that guarantees this torque for the rotation speed indicated in the design specifications

3. Check that the ball screw is suitable to support the required rotation speed

4. Choice of commercial stepper motor able to comply with the required specifications

5. Choice of commercial drive (driver) capable of correctly driving the motor referred to in point 1

6. Choice of programmable control device suitable according to IEC 61131 and compatible with the drive referred to in point 2

7. Choice of sensors necessary for a correct movement of the trolley (number, type, technology)

8. Realization of the wiring diagrams of the system made using the IEC 81346 and IEC 61355 standards

9. Realization of the GRAFCET diagram of the system in accordance with IEC 60848

10. Preparation of a software module using one of the languages defined by IEC 61131 and able to move the system through an HMI interface

11. Choose an IoT platform using an Industry 4.0 enabling technology

12. SWOT analysis of the system

(*) any additional assumptions must not alter the following project specifications

Project Specifications

• Screw diameter: 8 mm

• Screw pitch: L = 2 mm

• Screw material: steel UNI EN 10088 X 5 CrNi 18-10

• Outer diameter of the screw: 22 mm

• Total mother screw length: 15 mm

• Fixing holes: 4x3.5 mm

• Mother screw material: brass

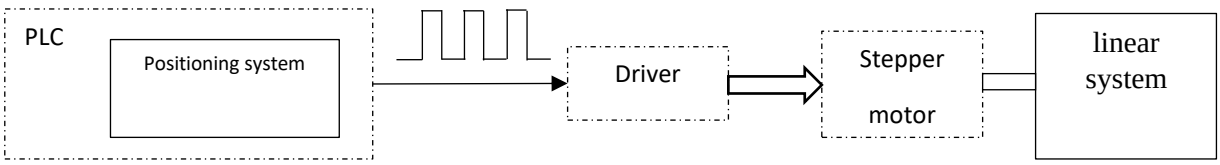
• Total length of 500 mm

• Total load: 50 N

• Rotation speed at engine speed: 1500 rpm

• Linear displacement speed of the trolley: 24 mm/s

Scheme of principles of the system



Required Skills already Acquired by Students

N°	Description
1	Algebra
2	Complex numbers
3	Vectors
4	Analytical Geometry
5	Derivatives and integrals
6	Electrical engineering and basic electronics
7	Drive mechanics
8	Block diagram algebra
9	Fundamentals of mechanics and machines
10	Spreadsheets
11	Software development environment for IEC 61131 compliant programmable devices
12	Electrical design environment in accordance with IEC 81346 3 IEC 61355

Output Competencies Acquired by Students

Competence n°	Description
1	Control Systems
2	Digital control systems
3	Sensors
4	Remote control of systems
5	Remote Maintenance
6	Systems Diagnostics
7	Data Acquisition
8	IoT
9	Industry 4.0

How to work transnationally

- The challenge has to be undertaken by transnational groups of 5 to 10 students (ideally 2 from each partner school/VET organisations); it is recommended that each group has a get-together virtual meeting before starting the real work, to know one another and agree communication rules and timing
- Participation should not necessarily involve all students who took part in a New METRO piloting activity, but those who can work in English and express a high motivation level to have a transnational learning experience, short but based on intense collaboration amongst various team members and teams
- In every partner school/VET organization a coordination person/small team has to be established, in charge of selecting/recruiting the interested student, of supporting students during their work and contributing to the evaluation of the transnational learning experience (individual and group work, process organization and learning outcomes, specific value of transnational cooperation, coherence with competences units developed by the project, importance of transversal skills,..)
- Due to contractual and practical reasons, the whole exercise should not take more than 16 working hours for each student in an interval of 2 to 4 weeks, between February and mid March 2022.

DESIGN OF A CONTROLLED LINEAR SYSTEM

Assessment Model

GROUP N°……..

GROUP MEMBERS……..

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N°	Test Section	Level	Description	Points	Points assigned
1	**Calculation of required torque for application** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
2	**Calculation of power to guarantee required torque** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
3	**Ball Screw Verification** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	

N°	Test Section	Level	Description	Points	Points assigned
4	**Selection of motor** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
5	**Selection of driver** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
6	**Selection of IEC 61131-compliant programmable device** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
7	**Selection of sensor** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
8	**Electrical diagram in accordance with IEC 81346 and 61355** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	

N°	Test Section	Level	Description	Points	Points assigned
9	**GRAFCET diagram creation** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
10	**Software module with IEC 61131 language and HMI interface** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
11	**Selection of IoT platform and Industry 4.0 technology** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
12	**SWOT Analysis** Max score: 5 points Sufficient: 3 points	0	Not calculated or with serious errors	0-1	
		1	Task performed substantially correctly (sufficiency)	2 – (**3**)	
		2	Done correctly with critical analysis of data and inclusion of additional inputs	4-5	
			POINTS TOTAL **(sufficiency)**	60 **(36)**	
			POINTS TOTAL/100 **(sufficiency)**	100 **(60)**	

EVALUATORS **DATE**

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