

MECN 4029A MECHATRONICS II

23 FEBRUARY 2024

CLASS ASSIGNMENT

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SWE 110D

CLASS ASSIGNMENT

- Each student registered for this course is required to perform a mechatronic systems design assignment; the objective of which is to gain better understanding of the principles covered in the syllabus.
- Students groups: max 4 members.
- Students can add themselves into available groups.
<https://ulwazi.wits.ac.za/courses/55030/groups#tab-13789>
- 25% OF COURSE MARK!

CLASS ASSIGNMENT

2. ASSIGNMENT TOPIC & PARTNERSHIP WITH MATHWORKS

- The 2024 Mechatronics II assignment is a joint endeavor between MathWorks and the School. Students will need to visit GitHub to access the assignment webpages:
- <https://github.com/mathworks/MATLAB-Simulink-Challenge-Project-Hub>
- MathWorks has collated resources for these projects which can be found when accessing the GitHub page weblink given above.
- You will also have access to discussion forums where you can interact with students across the world who are also working on the same projects. The forums are moderated by MathWorks engineers, who will answer any questions posted in the forum.



CLASS ASSIGNMENT

2. ASSIGNMENT TOPIC & PARTNERSHIP WITH MATHWORKS

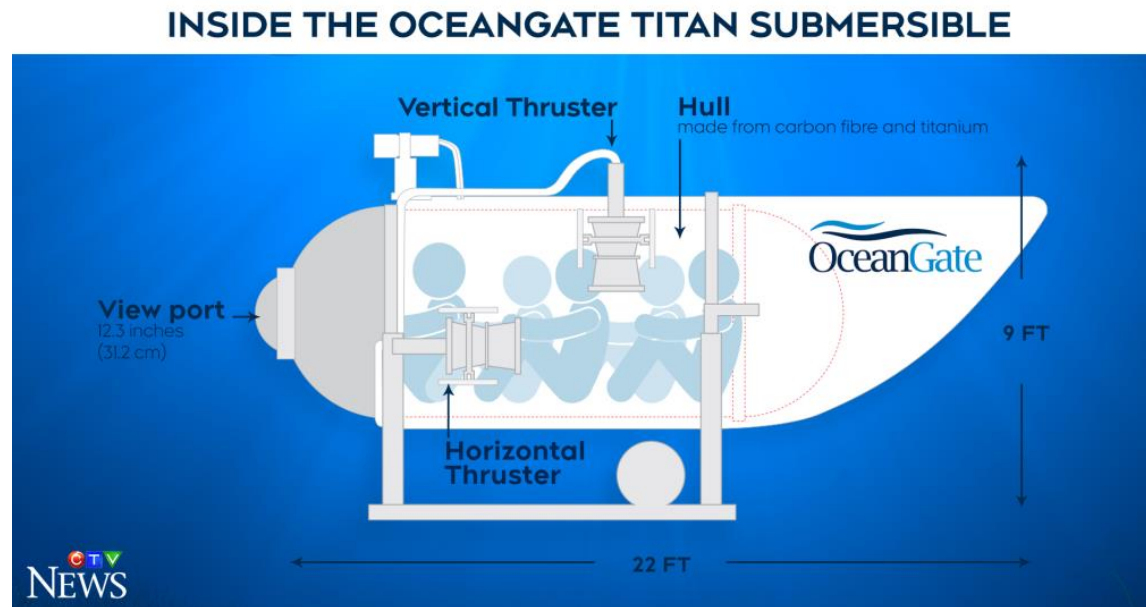
- Students who successfully complete the assignment in the course Mechatronics II will be awarded with a certificate issued by MathWorks. The best project will receive a LinkedIn endorsement by a MathWorks engineer. Both the certificate and the LinkedIn endorsement are unique to the Mechatronics II course assignment.



- Moreover, as the selected projects are part of the official MathWorks program called “MATLAB and Simulink Project Challenge”, students will have the possibility to gain an international recognition for official internship at MathWorks. Remember to sign up for the project and, upon completion, submit your solution to gather your additional certification.
- As this is your final year, this will count positively towards your employment journey once you have completed your degree.

CLASS ASSIGNMENT

- Project choice inspired by real world issues that are topical:
 - Tragic 2023 incident of the Titan submersible – an underwater vehicle



<https://www.ctvnews.ca/sci-tech/titanic-expedition-here-s-what-it-was-like-inside-the-titan-submersible-1.6450554>

CLASS ASSIGNMENT

- Project choice inspired by real world issues that are topical:
 - Major increase in solar power generation in South Africa due to loadshedding

https://en.wikipedia.org/wiki/Solar_power_in_South_Africa

In 2022, South Africa's shift to solar power was marked by a 24% increase in small-scale solar generating capacity. This growth is evidenced by the import of solar PV panels worth 2.2 billion rand, adding over 500 megawatts of capacity in just the first five months. Predominantly,

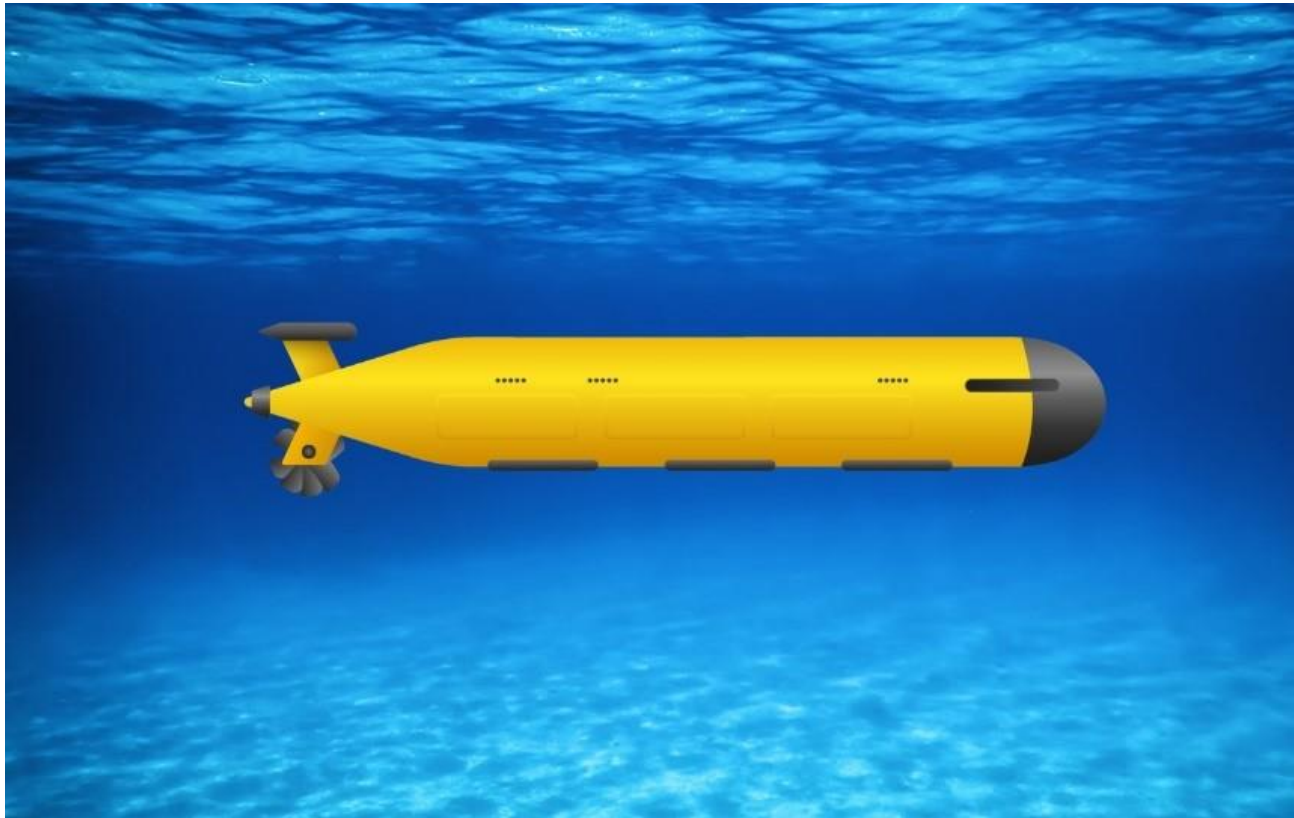


<https://www.reuters.com/world/africa/south-africas-silent-revolution-those-with-cash-go-solar-2022-08-15/>

CLASS ASSIGNMENT

- Choose between the following 2 projects

PROJECT A. Underwater Drone Hide and Seek



Maritime applications:

MECHANICAL ENGINEERING

**Doesn't matter if you
are Mech or Aero.
Any stream can choose this
topic!**

CLASS ASSIGNMENT

PROJECT A. Underwater Drone Hide and Seek



Underwater Drone Hide and Seek

After robots conquered ground, sky and space, they are going deep sea next. Explore the frontier of autonomous underwater vehicles by doing a project on robot collaboration and competition underwater.

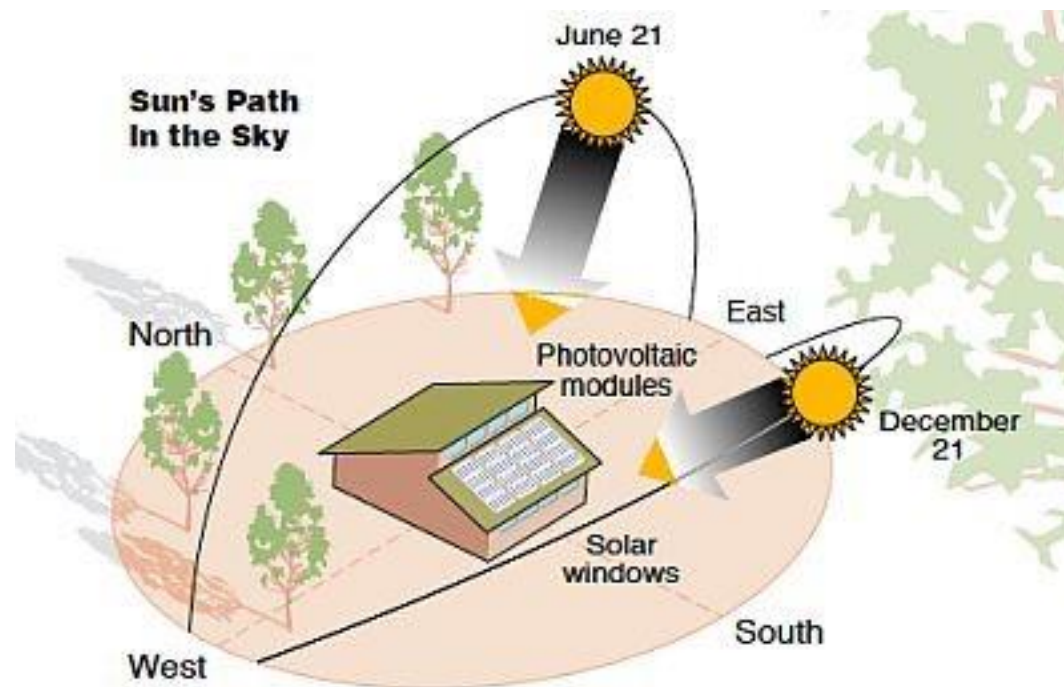
Motivation

Artificial intelligence and sensor technologies have pushed the boundary of how human explore uncharted spaces both above our heads and below our feet. Underwater drones have been mapping the global seafloor and constructing undersea internet cables for years. Now they are getting more collaborative; we are seeing increasing amount of robot fleets perform a single task in a coordinated way. What is the next frontier following collaborative robots? Could it be competitive robots?

CLASS ASSIGNMENT

- Choose between the following 2 projects

PROJECT B. Solar Tracker



**Movable solar systems are
MECHANICAL + ELEC
SYSTEMS**

**Doesn't matter if you
are Mech or Aero.
Any stream can choose this
topic!**

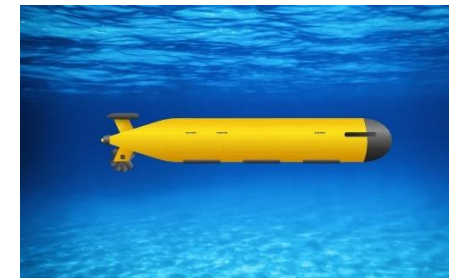
CLASS ASSIGNMENT

- Choose between the following 2 projects

PROJECT A. Underwater Drone Hide and Seek

- For an underwater drone, you could consider, for example, depth control, OR pitch-axis control, OR attitude / heading control, OR speed control, etc.
...
- Develop a scenario for the underwater drone which will be the basis for your assignment, e.g., maintain a certain depth while inspecting undersea infrastructure ABC XYZ, another example, maintain a certain heading while tracking a particular object/target, etc., or any other scenario you come up with.

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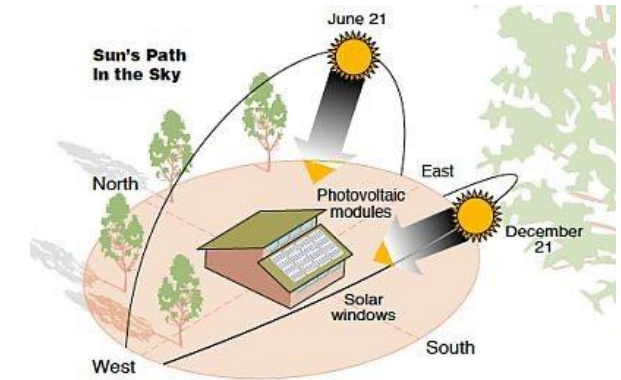
Any stream can choose this
topic!

CLASS ASSIGNMENT

- Choose between the following 2 projects

PROJECT B. Solar Tracker

- Develop a controller for the single-axis solar tracker
- The control system should be designed to optimize the tracking of the sun's path, ensuring the solar panel maintains the best possible angle for energy absorption throughout the day
- Develop a scenario for the solar tracker which will be the basis for your assignment, e.g., solar power for a corporate office block in city XYZ. This scenario will form the basis from which you will draw performance specifications for your controller[s].



CLASS ASSIGNMENT

- BONUS MARKS UP FOR GRABS FOR BOTH PROJECTS

PROJECT A

As outlined on the Github webpage: Develop an algorithm to navigate a stealth underwater drone through a radar region (treat radar sweeps as if dynamic obstacles) without being detected. Develop another algorithm to navigate a second underwater drone, which is equipped with a fixed scanning frequency radar, to search for the stealth drone.

PROJECT B

As outlined on the GitHub webpage: Develop a multi-axis solar tracker with appropriate control for each and every motor. Analyze the efficiency of the solar panel system with and without the solar tracker using MATLAB, employing tools such as the Solar Position Algorithms for solar radiation.

Please make sure that as you execute your assignment, you demonstrate your skills in the required modelling, analysis and implementation BEFORE bringing in the bonus scenario.

CLASS ASSIGNMENT

4.SUBMISSION

- The final submission date for the assignment is Monday 13 May 10:00 am. Take note that submission will be on-line at the MECN4029A Ulwazi Website
- <https://ulwazi.wits.ac.za/courses/55030/assignments>
- ***Late assignments' submissions will be penalised as follows:***
 - 10% for the first 24 hours or part thereof.
 - An additional 10% penalty will then apply on the second day and any assignment handed in on the third day will not be able to obtain a mark greater than 50%.
 - Any submission after the third day (weekend included) will be deemed to be Failed Absent and may result in withdrawal of permission to write the final examination.

CLASS ASSIGNMENT

4.SUBMISSION

- Once you have submitted on Ulwazi, you can upload your submissions on the GitHub site as explained in Section 2 above.
- Please, be aware that the GitHub submission will entitle you to participate in the worldwide program “MATLAB and Simulink Challenge Projects” and obtain the official MathWorks internship certification.



CLASS ASSIGNMENT

5. MARK BREAKDOWN

Assessment Area	Description	Max Marks
Application of theoretical knowledge	Effective and accurate application of relevant theories and concepts learned during the academic career	30
Tools proficiency	Demonstrated skill and understanding in using the tools effectively	10
Effectiveness and depth of solution	Extent of meeting objectives and how well it addresses the problem.	20
Quality of implementation	Robustness, reliability, and performance of the technical solution	20
Real-world applicability	Feasibility and scalability of the solution for real-world implementation)	5
Quality of documentation	Comprehensive and clear project documentation	15
	TOTAL	100
	BONUS POINTS	10

CLASS ASSIGNMENT

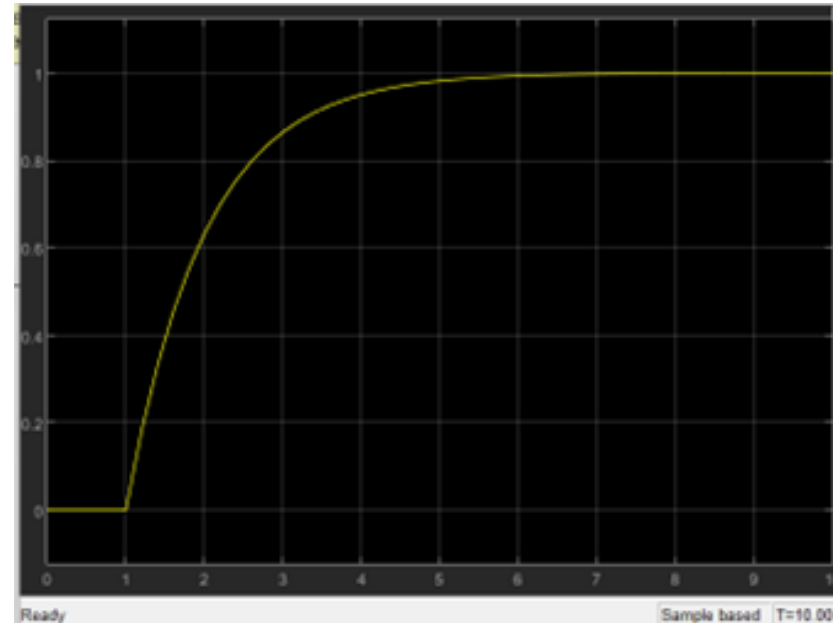
6.PLAIGIRISM

- The 2024 assignment format allows you to interact with other students around the world who are also working on the same project.
- Additionally, MathWorks has made resources available for students who have selected these projects.
- You are reminded that you will need to provide citations to all work that is not your own.
- If you intend to make use of AI-based tools, you will need to explain their use in your project report, along with providing citations to the tool[s] that you have used.

CLASS ASSIGNMENT

7.PROCESSING AND PRESENTATION OF RESULTS IN THE REPORT

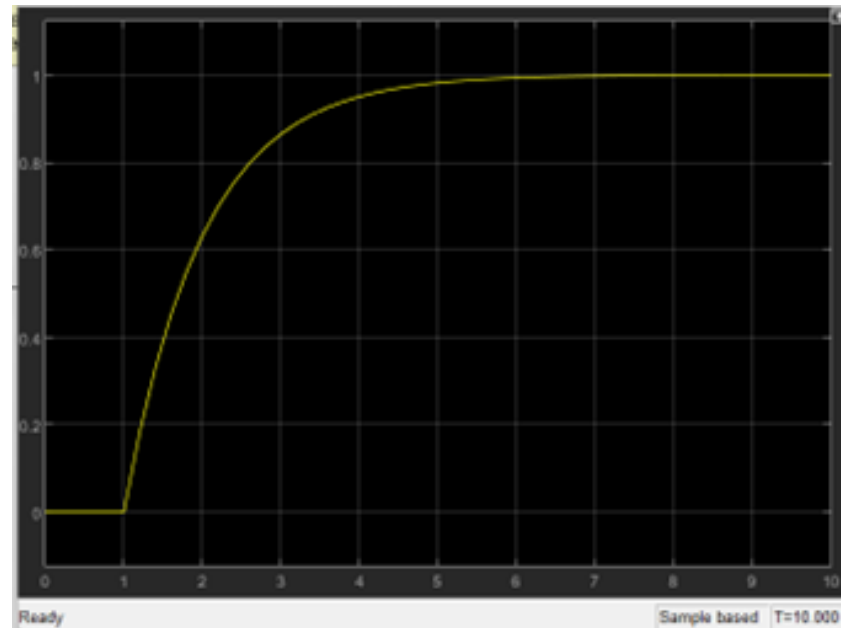
- As stated in the Course Outline and as indicated earlier, this assignment will also be assessed on the effectiveness of communication in the written answers.
- Neat, legible, clear and clearly labelled diagrams will help here.
- **Simulink screenshots without any processing will obtain 0 (zero) marks. (See screenshot below)**



CLASS ASSIGNMENT

7.PROCESSING AND PRESENTATION OF RESULTS IN THE REPORT

- **Simulink screenshots without any processing will obtain 0 (zero) marks. (See screenshot below)**



- Students will be provided with a guide that shows how data from Simulink can be exported to the MATLAB workspace for further processing and plotting, where figures can be exported in images for insertion into the report.

CLASS ASSIGNMENT

7.PROCESSING AND PRESENTATION OF RESULTS IN THE REPORT

- It is important when performing computer-based assignments that students do not invest excessive time in producing and processing of results: **do not present vast numbers of unnecessary simulation outputs in your reports.**

CLASS ASSIGNMENT

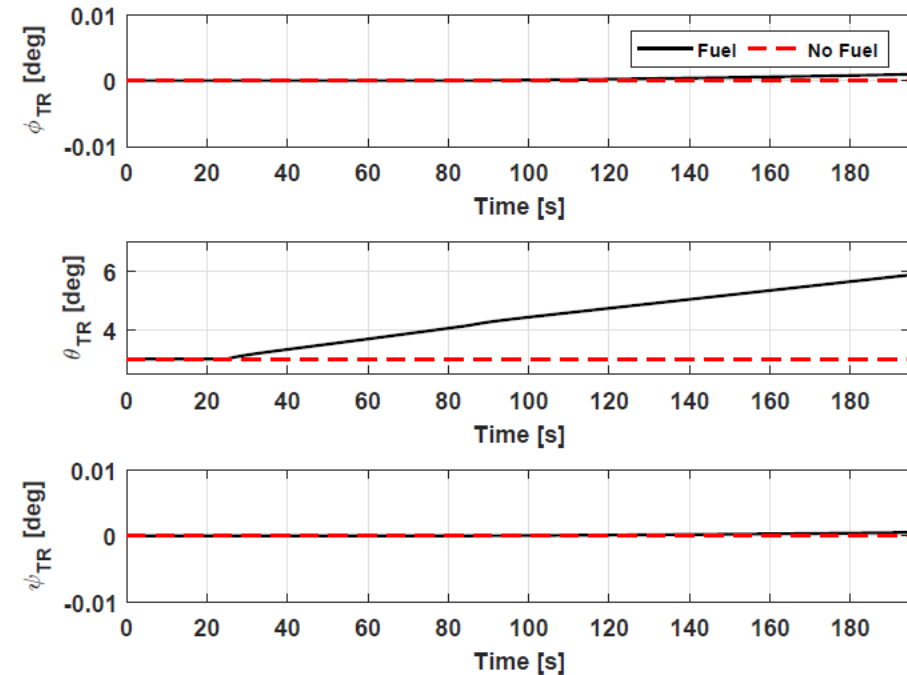
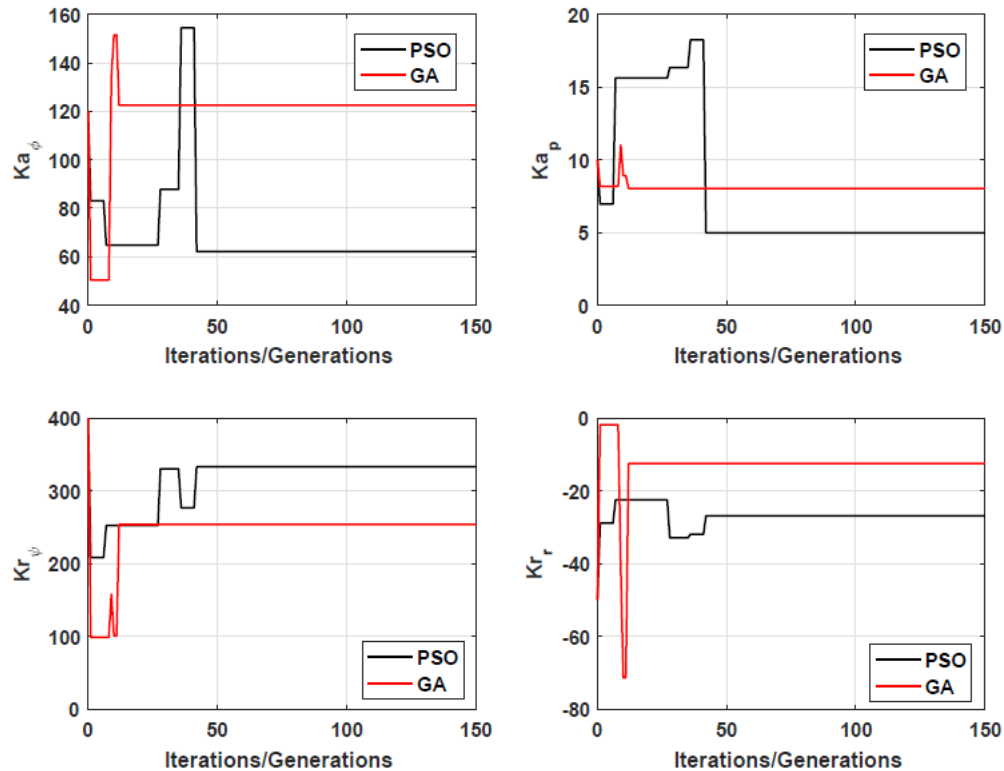
7.PROCESSING AND PRESENTATION OF RESULTS IN THE REPORT

- It is important when performing computer-based assignments that students do not invest excessive time in producing and processing of results: **do not present vast numbers of unnecessary simulation outputs in your reports.**
 - Instead, you are encouraged to make use of subplots to condense multiple related plots into 2X2, or 3X1 or whatever format is most efficient.
 - You are also encouraged to overlay results where applicable, e.g., step response of the linear and nonlinear plant can be overlayed and labelled. The linear plant for example, can have a straight line, whereas the nonlinear plant can have a dashed-line or they can be in different colours.

CLASS ASSIGNMENT

7.PROCESSING AND PRESENTATION OF RESULTS IN THE REPORT

- Some example images from my PhD thesis



CLASS ASSIGNMENT

8.PROJECT PLANNING & COORDINATION

- You are expected to manage your own time and create your own workplan with your group (this need not be submitted in the report).
- Please ensure that tasks are shared amongst group members.
- You may make use of consultation sessions with me should you have any questions regarding the assignment.

CLASS ASSIGNMENT

CREDIT FOR 2023 ASSIGNMENT

- Please apply – I will send an announcement

MINI ASSIGNMENTS

- Group Submissions
- Those not doing 2024 assignment can be grouped together