`EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*Y*
ID:	**AP1**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Feedback Control of the Cheetah Tail	
DESCRIPTION:	 *Figure 1: Cheetah during hunt (https://www.disney.com.au/national-geographic)* The cheetah is capable of rapid manoeuvres at high-speed, yet we still do not understand its mechanics. Particularly, the exact reason for its tail swinging motions are still debated. One hypothesis is that the tail is being used as a stabiliser during rapid acceleration and another is that the tail is used as a "rudder" to turn or roll the cheetah body. Feedback control has been shown to be a powerful tool in understanding sensor-motor control in animals. In this project, we propose to utilise methods from feedback control to study the closed-loop response of tail swinging during rapid locomotion. The student will have access to all the cheetah videos obtained by the Mechatronics Group.	
DELIVERABLES:	• Develop a simple 3d kinematics model of the cheetah (derived from motion capture) • System identification of several transfer function models with tail motion as the control input • Analysis and comparison between transfer function models	
SKILLS/REQUIREMENTS: **Include any software requirements**	**<u>Strong</u> mathematical and programming skills. This project is challenging but a strong student will be very successful with it.** **EEE4114F, EEE4118F or EEE4119F as a prerequisite**	
GA1: Problem solving: *Identify, formulate, analyse and solve*	The student will need to apply linear feedback control to understand the neuromechanics of animal locomotion	

complex engineering problems creatively and innovatively*	
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform simulation experiments and analyse the results of the derived closed-loop system.
EXTRA INFORMATION:	**Closed-loop biomechanics:** • https://www.sciencedirect.com/science/article/pii/S095943881300216X • https://academic.oup.com/icb/article/54/2/223/2797832 • https://www.pnas.org/content/113/45/12832.full **Cheetah:** • https://www.nature.com/articles/nature12295#:~:text=A%20remarkable%20top%20speed%20of,power%20for%20any%20terrestrial%20mammal%20. • https://ieeexplore.ieee.org/abstract/document/6697154 • https://bio.biologists.org/content/5/8/1072?utm_source=TrendMD&utm_medium=cpc&utm_campaign=Biol_Open_TrendMD_1
AREA:	Control Engineering, Biomechanics
Project suitable for ME/ ECE/EE/ All programmes?	ME or ECE

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- are ill-posed, under- or over-specified, or require identification and refinement;
- are high-level problems including component parts or sub-problems;
- are unfamiliar or involve infrequently encountered issues;

and their solutions have one or more of the characteristics:

- are not obvious, require originality or analysis based on fundamentals;
- are outside the scope of standards and codes;
- require information from variety of sources that is complex, abstract or incomplete;
- involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

****NOTE: GA 4:** The balance of **investigation and experiment** should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline. An **investigation differs from a design** in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

Plan B: If the project above requires lab access, describe how a student who cannot get to campus can complete the project remotely. Keep in mind that all projects still need to meet all of the Graduate Attributes associated with the course, in particular GA 1 & 4: *Identify, formulate, analyse and solve complex engineering problems creatively and innovatively AND Demonstrate competence to design and conduct investigations and experiments.*

1. **Describe how you will get hardware to a student who cannot work on campus:**

N/A

OR

2. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

`EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*Y*
ID:	**AP2**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Transient Aerodynamics of the cheetah tail	
DESCRIPTION:	 *Figure 2: Cheetah tails* The Mechatronics Lab has previously shown that the cheetah tail has significant aerodynamic effects which are hypothesised to assist it during rapid acceleration. However, these tests were only performed under static conditions and do not replicate the conditions of the cheetah during hunting. Recently, we performed several actuated tests where cheetah pelts were connected to a brushless DC motor and accelerated (flicked) while in the UCT Mechanical Engineering Wind Tunnel. This project will utilise the measurements and investigate the aerodynamics of accelerating tails.	
DELIVERABLES:	• Calibrate the test data by removing biases (weight and inertial effects) and filtering • Derive a statistical model for the three principal tail flicks (roll, pitch and yaw) • Compare the forces obtained to the previous static wind tunnel tests	

SKILLS/REQUIREMENTS: Include any software requirements	Mathematical and programming skills **EEE4119F is a prerequisite**
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	The student will need to apply signal processing, mechanical modelling and state estimation to the problem of aerodynamics.
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform simulation, experiments and analyse the wind tunnel results.
EXTRA INFORMATION:	Cheetah tails • https://bio.biologists.org/content/5/8/1072?utm_source=TrendMD&utm_medium=cpc&utm_campaign=Biol_Open_TrendMD_1 • https://www.cmu.edu/me/robomechanicslab/ws/papers/Patel-RSSTails2018.pdf
AREA:	Mechanics, Signal Processing
Project suitable for ME/ ECE/EE/ All programmes?	ME

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- involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

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Plan B: If the project above requires lab access, describe how a student who cannot get to campus can complete the project remotely. Keep in mind that all projects still need to meet all of the Graduate Attributes associated with the course, in particular GA 1 & 4: *Identify, formulate, analyse and solve complex engineering problems creatively and innovatively AND Demonstrate competence to design and conduct investigations and*

experiments.

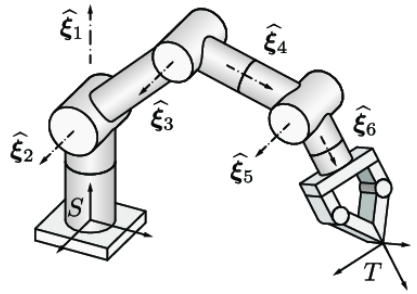
3. Describe how you will get hardware to a student who cannot work on campus:

N/A

OR

4. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*Y*
ID:	**AP3**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Multibody dynamics problem generator	
DESCRIPTION:	 *Figure 3: Robot arm* Automation of mechanical systems has become a crucial skill for the modern mechatronics engineer and online learning is becoming much more important given the global pandemic. This project will involve the development of a Matlab tool for teaching multibody dynamics problems. The tool will automatically generate a random system and then derive its equations of motion in a step by step fashion. Information about the system such as energy and angular velocity will also be available for the user. Lastly, the tool should also enable the automatic design of feedback linearised controllers as well as animation of movement.	
DELIVERABLES:	Develop a Matlab application with the following requirements: • Kinematics derivation (3D angular velocity) • Dynamics derivation (using Euler-Lagrange Mechanics) • Feedback Linearization (For fully and underactuated systems) • GUI interface and notebook (Matlab Live) • Animation of system	
SKILLS/REQUIREMENTS: **Include any software requirements**	Mathematical and programming skills **EEE4119F is a prerequisite**	
GA1: Problem solving: *Identify, formulate, analyse and solve*	The student will need to apply software design and mechanics techniques to develop the application	

complex engineering problems creatively and innovatively*	
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform simulation, experiments and analyse the results of the software.
EXTRA INFORMATION:	Matlab Live Editor: https://www.mathworks.com/products/matlab/live-editor.html
AREA:	Mechanics, Software Engineering
Project suitable for ME/ ECE/EE/ All programmes?	ME

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Plan B: If the project above requires lab access, describe how a student who cannot get to campus can complete the project remotely. Keep in mind that all projects still need to meet all of the Graduate Attributes associated with the course, in particular GA 1 & 4: *Identify, formulate, analyse and solve complex engineering problems creatively and innovatively AND Demonstrate competence to design and conduct investigations and experiments.*

5. Describe how you will get hardware to a student who cannot work on campus:

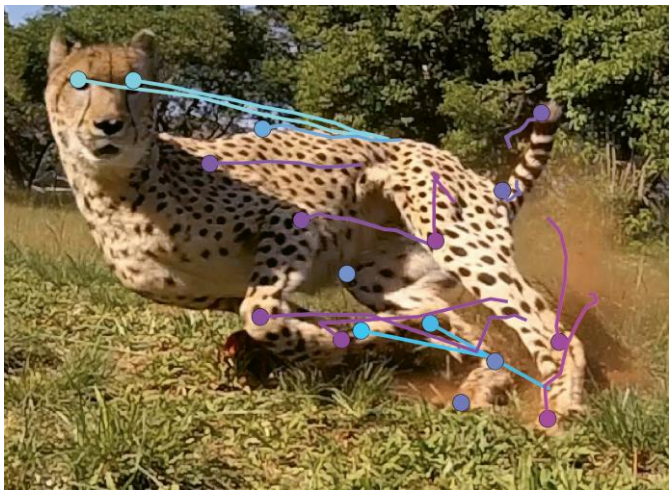
N/A

OR

6. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*Y*
ID:	**AP4**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Marker-less Motion Capture in the Wild using Optimization	
DESCRIPTION:	 *Figure 4: Cheetah pose estimated by Deeplabcut* Deep learning has enabled advances in 3D pose estimation of animals and human subjects. However, these algorithms only process a single frame at a time (which means they ignore time information) and as such are not very robust when used in the wild (outside the lab). The Mechatronics Lab has recently combined a marker-less motion capture algorithm (*Deeplabcut)* with Moving Horizon Estimation (MHE). This enabled robust skeletal tracking of free-running cheetahs by utilising the kinematic structure of the system (the skeleton) as well as the temporal information. In this project, the student will be required to implement these two concepts into a Python toolbox (or addition to *Deeplabcut*) which will enable robust 3D tracking of any animal (humans included) in the wild.	
DELIVERABLES:	Develop a Python toolbox with the following requirements: • User input to define skeleton parameters (possibly using a GUI) • Perform trajectory estimation using an optimisation package (Pyomo) • Visualisation/animation of results	

SKILLS/REQUIREMENTS: Include any software requirements	**Strong mathematical and programming skills** **EEE4114F, EEE4118F or EEE4119F as a prerequisite**
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	The student will need to apply signal processing, mechanical modelling and state estimation to the problem of motion capture.
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform software experiments and analyse the motion capture results.
EXTRA INFORMATION:	Papers: • https://www.nature.com/articles/s41596-019-0176-0 • https://link.springer.com/content/pdf/10.1007/978-3-319-58821-6.pdf • https://link.springer.com/chapter/10.1007/978-3-0348-8407-5_3 • https://www.sciencedirect.com/science/article/pii/S0098135413003712?casa_token=ii-FjmkVyKEAAAAA:nFucHgjC6qUUs8RxieUrRrwnj5oQdREjSvfeXeK-y3yD7GwsArXEpHojR8tfvYKw-RUMW7q88w
AREA:	Machine Learning, State Estimation
Project suitable for ME/ ECE/EE/ All programmes?	ME or ECE

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****NOTE: GA 4:** The balance of **investigation and experiment** should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline. An **investigation differs from a design** in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

Plan B: If the project above requires lab access, describe how a student who cannot get to campus can complete the project remotely. Keep in mind that all projects still need to meet all of the Graduate Attributes associated with the course, in particular GA 1 & 4:

Identify, formulate, analyse and solve complex engineering problems creatively and innovatively AND Demonstrate competence to design and conduct investigations and experiments.

7. Describe how you will get hardware to a student who cannot work on campus:

N/A

OR

8. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*Y*
ID:	**AP5**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Bird-inspired Landing Control for Fixed-Wing Drones	
DESCRIPTION:	 *Figure 5: Bird Landing on Branch* Birds are extremely agile and capable of landing on a multitude of surfaces in windy and turbulent conditions. A recent paper has revealed that the importance of limbs during take-off and landing has been overlooked by biologists. Fixed-wing drones offer much higher cruising speeds however, they require hand-launching or a long runway. Conversely, quadcopters can robustly land on a multitude of surfaces but are unable to achieve high cruising speeds. Vertical Take-off and landing drones (VTOL) offer a combination of both but the control of the transition period (from hover to flight) is complex. Inspired by birds, this project will use trajectory optimisation to investigate if fixed wing drones will be able to land more robustly on surfaces using legs. These results will inform the design of future aerial robotic systems for transportation and delivery.	
DELIVERABLES:	The student will be required to perform the following: • 2D modelling of a fixed wing aircraft (including aerodynamic forces) • Amending model to include a single leg (two rigid links) • Trajectory optimisation of the landing manoeuvre in various conditions (frictions, moving platform like ships, wind, etc.)	

SKILLS/REQUIREMENTS: **Include any software requirements**	**Strong mathematical and programming skills** **EEE4114F, EEE4118F or EEE4119F as a prerequisite**
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	The student will need to apply feedback control, mechanical modelling and optimization to the problem of autonomous landing.
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform software experiments and analyse the results of the system with and without the addition of legs.
EXTRA INFORMATION:	Papers: • https://elifesciences.org/articles/46415 • https://asmedigitalcollection.asme.org/mechanismsrobotics/article-abstract/11/6/061002/956236/A-Bird-Inspired-Perching-Landing-Gear-System1?redirectedFrom=fulltext • https://jeb.biologists.org/content/217/15/2659 • http://groups.csail.mit.edu/robotics-center/public_papers/Cory08.pdf
AREA:	Bio-inspired robotics, Optimal Control, Aeronautics
Project suitable for ME/ ECE/EE/ All programmes?	ME

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Identify, formulate, analyse and solve complex engineering problems creatively and innovatively AND Demonstrate competence to design and conduct investigations and experiments.

9. Describe how you will get hardware to a student who cannot work on campus:

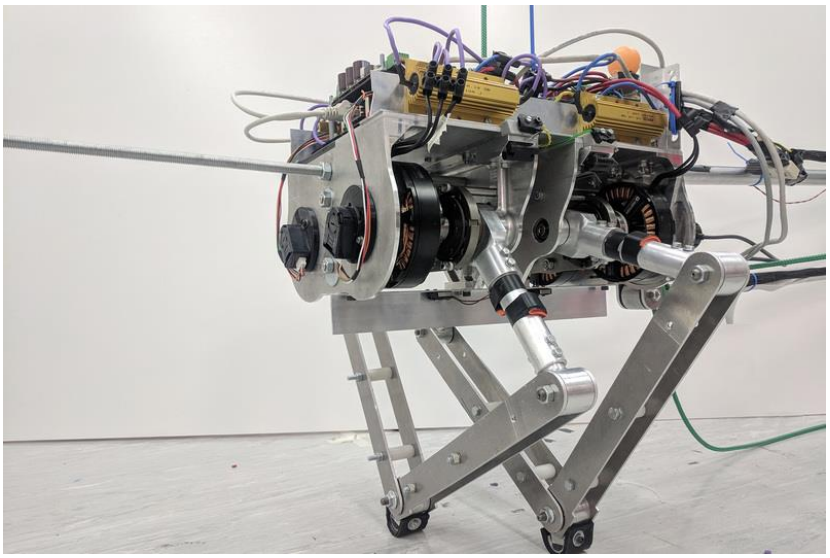
N/A

OR

10. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*Y*
ID:	**AP6**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Optimisation-Inspired Control Policies for Robotic Systems	
DESCRIPTION:	 *Figure 6: Baleka bipedal robot* Robotic systems are challenging to control as they are often lack closed-form solutions or have high dimensionality. Optimisation-inspired control (akin to bio-inspired robotics) has been proposed as a technique to overcome this by solving many offline optimal control problems and then observing these for analytical insights and patterns. This project will involve investigating this idea by developing optimal controllers for two simple systems (an acrobot and a bipedal robot) from a variety of initial conditions. These will then be inspected for patterns in order to gain insight and design of linearised feedback controllers. If time allows, these results can be used to train a Neural Network Based Controller.	
DELIVERABLES:	The student will be required to perform the following: • Model two mechanical systems (acrobot & biped robot) • Trajectory optimisation of each under varying initial conditions and disturbances • Inspections of results and analysis of patterns • Comparison of feedback controller and optimised results	

SKILLS/REQUIREMENTS: Include any software requirements	**Strong mathematical and programming skills** **EEE4114F, EEE4118F or EEE4119F as a prerequisite**
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	The student will need to apply feedback control, mechanical modelling and optimization to the problem of robotic control.
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform software experiments and analyse the results of the feedback controller and the trajectory optimization results.
EXTRA INFORMATION:	Papers: • https://mime.oregonstate.edu/research/drl/publications/_documents/hubicki_2011a.pdf • https://static1.squarespace.com/static/5685a33005f8e23aa27901d3/t/5764f51e20099e29740b5e42/1466234143083/Hubicki_Hurst_2012.pdf • https://ieeexplore.ieee.org/abstract/document/8758791/
AREA:	Bio-inspired robotics, Optimal Control
Project suitable for ME/ ECE/EE/ All programmes?	ME

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Identify, formulate, analyse and solve complex engineering problems creatively and

innovatively AND Demonstrate competence to design and conduct investigations and experiments.

11. Describe how you will get hardware to a student who cannot work on campus:

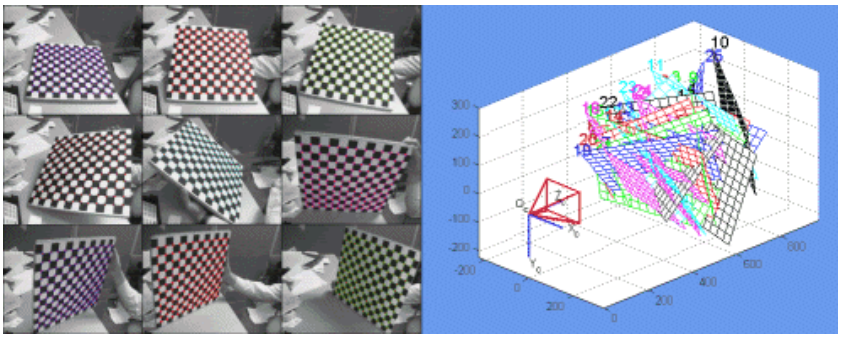
N/A

OR

12. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*N*
ID:	**AP7**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	Automatic Multi-Camera Extrinsic Calibration in the Wild	
DESCRIPTION:	 *Figure 7: Camera calibration using a checkerboard* Camera calibration entails the calculation of the pose (position and orientation) of multiple cameras relative to a reference frame. This is critical for accurate 3D reconstruction in the wild (outside the lab). Typically, this is done automatically with a checkerboard but require some manual labelling if more than two cameras are involved. Another method is to use a wand (measurement stick), which can be seen by all cameras at the same time, but this also requires manual calibration. In this project, the student is required to develop an automatic method of calibration of six cameras. This can be done by constructing a geometric shape with LEDs which can be automatically seen by all cameras at the same time.	
DELIVERABLES:	The student will be required to perform the following: • Build a simple geometric shape with LEDs • Develop algorithm for automatically finding shape in a video frame (can use Machine Learning) • Use these shape points to perform extrinsic calibration of the camera set	
SKILLS/REQUIREMENTS: **Include any software requirements**	**Strong mathematical and programming skills** **EEE4114F, EEE4118F or EEE4119F as a prerequisite**	
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and*	The student will need to apply machine learning, compute vision and optimization to the problem of camera calibration.	

innovatively	
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform experiments and compare the results to the conventional checkerboard method.
EXTRA INFORMATION:	Papers: • https://docs.opencv.org/2.4/modules/calib3d/doc/camera_calibration_and_3d_reconstruction.html • https://jeb.biologists.org/content/217/11/1843.abstract?sid=af9b277b-1e83-49d8-bf0e-dea56ea82111
AREA:	Computer vision, Machine Learning
Project suitable for ME/ ECE/EE/ All programmes?	ME or ECE

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****NOTE: GA 4:** The balance of **investigation and experiment** should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline. An **investigation differs from a design** in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

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13. Describe how you will get hardware to a student who cannot work on campus:

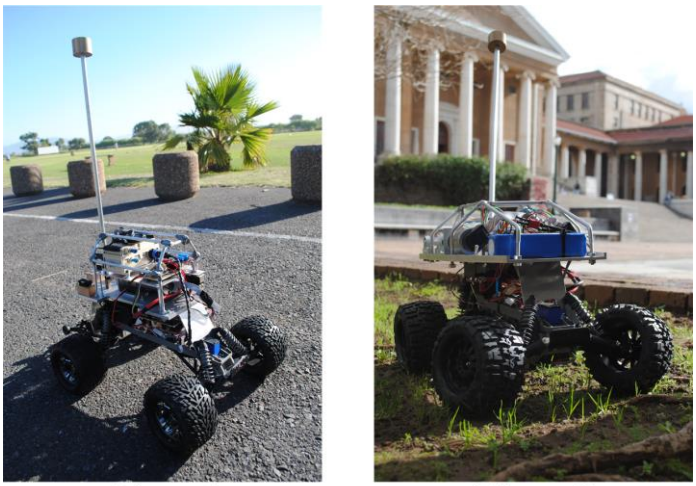
The project can only be selected by a student based in South Africa (preferably Cape Town). The following components will be delivered to students: • LEDs • GoPro Cameras • Checkerboard • Any 3D printed parts

OR

14. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

EEE4022S/F Topic template

Student proposed?	*Y/N*	*N*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*N*
ID:	**AP8**	
SUPERVISOR:	Dr. Amir Patel	
TITLE:	GPU-based Embedded Control System for *Dima*	
DESCRIPTION:	 *Figure 8: Dima I and the latest version Dima II* The Mechatronics Lab is investigating manoeuvrability of tailed robots with the custom-built robot (*Dima II*). The robot's embedded control system currently consists of a custom PCB with a STM32F4 running a real-time operating system (FreeRTOS). The control system is responsible for reading sensor (IMU and GPS) data, on-board logging, communication to a laptop (via Xbee), performing feedback control and actuation of the motors. This project will involve the development of a new control system using a *Nvidia Jetson Nano*.	
DELIVERABLES:	The student will be required to develop a control system with the following requirements: • Hard real time operation • Interfacing to car and tail motors • Reading and logging sensor data • Communication to host PC	
SKILLS/REQUIREMENTS: **Include any software requirements**	**Strong programming skills** **EEE4120F or EEE4114F as a prerequisite**	

GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	The student will need to apply embedded software engineering to the problem controlling the Dima robot
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform software and electronic experiments to demonstrate that the system has met the user requirements above
EXTRA INFORMATION:	Reading: • https://ieeexplore.ieee.org/abstract/document/6697154/ • https://www.sciencedirect.com/science/article/pii/S0164121219300160?casa_token=-FB3WfQsotoAAAAA:frNXCWePsnbv2geO8dxGi68tRg5mR8-Hfp8DC1m6a7hGmcXNpq_NUWW4Rsf0Cs5C3SO1RHB1Tg • https://rt.wiki.kernel.org/index.php/Main_Page • https://www.researchgate.net/publication/257921769_Open-Source_Real-Time_Robot_Operation_and_Control_System_for_Highly_Dynamic_Modular_Machines • https://developer.nvidia.com/embedded/jetson-nano-developer-kit
AREA:	Software Engineering, Embedded Systems
Project suitable for ME/ ECE/EE/ All programmes?	ECE

***NOTE: Complex engineering problems** require in-depth fundamental and specialized engineering knowledge and have one or more of the characteristics:

- are ill-posed, under- or over-specified, or require identification and refinement;
- are high-level problems including component parts or sub-problems;
- are unfamiliar or involve infrequently encountered issues;

and their solutions have one or more of the characteristics:

- are not obvious, require originality or analysis based on fundamentals;
- are outside the scope of standards and codes;
- require information from variety of sources that is complex, abstract or incomplete;
- involve wide-ranging or conflicting issues: technical, engineering and interested or affected parties.

****NOTE: GA 4:** The balance of **investigation and experiment** should be appropriate to the discipline. Research methodology to be applied in research or investigation where the student engages with selected knowledge in the research literature of the discipline. An **investigation differs from a design** in that the objective is to produce knowledge and understanding of a phenomenon and a recommended course of action rather than specifying how an artifact could be produced.

Plan B: If the project above requires lab access, describe how a student who cannot get to campus can complete the project remotely. Keep in mind that all projects still need to meet all of the Graduate Attributes associated with the course, in particular GA 1 & 4: *Identify, formulate, analyse and solve complex engineering problems creatively and innovatively AND Demonstrate competence to design and conduct investigations and*

experiments.

15. Describe how you will get hardware to a student who cannot work on campus:

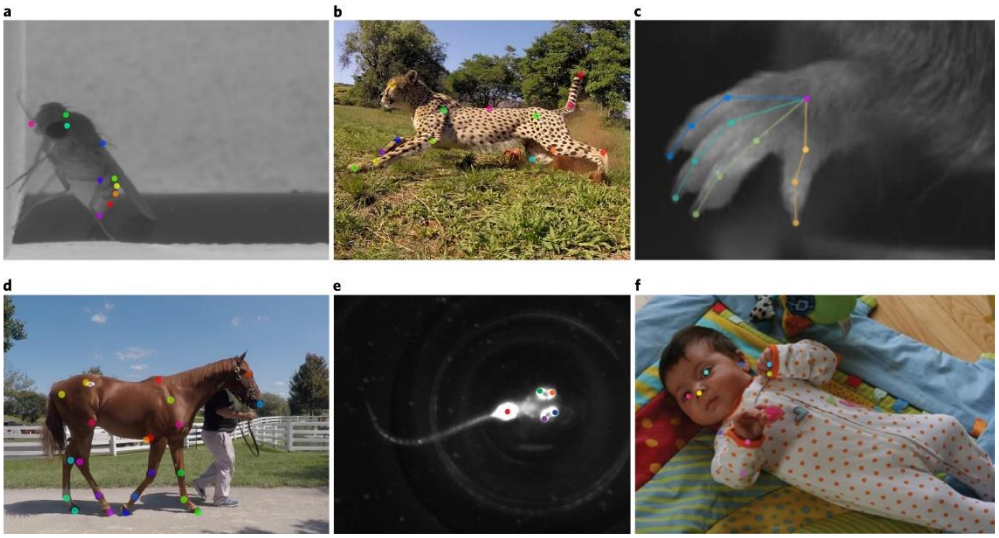
The project can only be selected by a student based in South Africa (preferably Cape Town). The following components will be delivered to students: • Nvidia Jetson • IMU+GPS Module

OR

16. Describe how the project will be adapted for a student who has to work remotely

DESCRIPTION:	N/A
DELIVERABLES:	N/A

EEE4022S/F Topic template

Student proposed?	*Y/N*	*Y (Zubair Martin - MRTZUB001)*
Can this project as described below be completed outside a lab, i.e. done remotely?	*Y/N*	*N*
ID:	**AP9**	
SUPERVISOR:	Dr. Amir Patel Dr. Sharief Hendricks (ESSS, Co-supervisor)	
TITLE:	Comparison between OpenPose and Deeplabcut for Sport Science Analytics	
DESCRIPTION:	 *Figure 9: Deeplabcut applied to various post estimation tasks* Markerless motion capture testing Sports Science beyond the limitation of a laboratory, in a more natural setting. Recently, researchers have utilised an existing human motion capture algorithm (OpenPose) to detect the motion of the athletes, however it was still not as accurate as the gold standard marker-based system (Vicon). This project will investigate the use of a customisable motion capture algorithm (Deeplabcut) to Sports Science applications. These results will be compared to OpenPose. Videos will be provided by the division of Exercise Science and Sports Medicine (ESSM) at UCT.	
DELIVERABLES:	The student will be required to perform the following: • Implement OpenPose and Deeplabcut for pose estimation tasks for four movements (Squat, ball-kicking, side-step and tackle) • Calculate metrics for sports scientist from video data (Energy, momentum) • Compare accuracy of the two methods	
SKILLS/REQUIREMENTS: **Include any software**	**Strong mathematical and programming skills** **EEE4114F, EEE4118F or EEE4119F as a prerequisite**	

requirements	
GA1: Problem solving: *Identify, formulate, analyse and solve complex* engineering problems creatively and innovatively*	The student will need to apply computer vision, mechanical modelling and optimization to the problem of sports analytics.
GA 4: Investigations, experiments and analysis:** *Demonstrate competence to design and conduct investigations and experiments.*	The student is expected to perform software experiments and analyse the results from the various videos.
EXTRA INFORMATION:	Papers: • https://arxiv.org/pdf/1812.08008.pdf • https://www.nature.com/articles/s41596-019-0176-0 • https://www.frontiersin.org/articles/10.3389/fbioe.2020.00181/full
AREA:	Computer Vision, Sports Science
Project suitable for ME/ ECE/EE/ All programmes?	ME

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17. **Describe how you will get hardware to a student who cannot work on campus:**

N/A

OR

18. **Describe how the project will be adapted for a student who has to work remotely**

DESCRIPTION:	N/A
DELIVERABLES:	N/A