MODELLING & SIMULATION APPROACH

2020

THE AUSTRALIAN UNIVERSITIES ROCKET COMPETITION

AYAA

The third assessed deliverable for the AURC 2020 is the modelling and simulation approach. This deliverable challenges teams to develop a plan for future work on the aspects associated with simulations through the use of either commercial or internally developed software. This is not a report for showing or producing results; it is instead to be focussed on the methodology and engineering approach.

As per the **AURC Competition Deliverables** document, the maximum length of the progress report is 20 pages. This page limit is from the introduction (p.1) to the conclusion; appendices are excluded from the page limit but are not to be used for storing run-over from the report body.

If your report exceeds the page limit, content past the 20th page (excluding the appendices) will not be marked. If completed in Microsoft Word or similar, the report must be written in size 12 pt. Times New Roman, have 'single' line spacing and must be presented in a professional and consistent manner, alternatively the use of LaTeX or comparable typesetting software is also permitted.

Required Information

This report is to contain the following information at a minimum, further detail can be added as teams see fit. Marking allocation for each section is included in brackets and the marking rubric.

- Executive summary (5%)
- Introduction (5%)
- Finite Element Analysis (25%)
    - Discuss how Finite Element Analysis is used; including its benefits and limitations.
    - Review of different software packages available.
    - Discuss how your selected Finite Element Analysis Software calculates loads
    - Provide an overview of the different components you will analyse, including a justification for which components were chosen, and the loading cases to be applied.
    - Justify the assumptions of your selected analysis cases and compare it to how it will react in reality.
- Computational Fluid Dynamics (25%)
    - Discuss how Computational Fluid Dynamic is used; including its benefits and limitations.
    - Review of different software packages available.
    - Discuss how your selected Computational Fluid Dynamics calculates outputs
    - Provide an overview of the different components you will analyse, including a justification for which components were chosen, and the loading cases to be applied.
    - Discuss the level of coupling between the software packages you will employ, and justify your choices (e.g. the output from one becomes the input for another software package).
- Flight Simulations (25%)
    - Identify benefits and limitations.

    - Discuss how your selected flight simulation software calculates the trajectory of the vehicle,
    - Provide an overview for a detailed sensitivity analysis and verification plan to validate the results for both software packages.
    - Discuss any relevant custom development or adaptations.
- Conclusion (5%)
- Appendices

Note that the presentation, formatting and language of the report will count for 10% of the total mark. This includes (but is not limited to) spelling and grammar, appropriate use of figures, concise explanations, referencing and well-presented layout. Standard (and critical) report components such as the reference list, table of contents, list of figures, list of tables, and cover page are also considered in this allocation of marks and should be included.

Further Information

As can be seen in the grading matrix, certain components are capped at 5 marks. Overall, we would like to ask you to read it carefully. Don't forget to provide research supporting your non-technical decisions as well as your design.

Clear presentation is important. Do not confuse the encouraged brevity of components with the amount of thought required. Research is vital in producing a high-quality report. Spelling, punctuation, grammar and formatting errors will be heavily penalised. It is recommended that you proofread your work thoroughly and ensure it is readable, logical, free from errors and consistently formatted (e.g. dot point formatting is consistent).

Then finally: any academic referencing method is acceptable, but it must be applied consistently. Read the provided Grading Matrix carefully and if you have any remaining concerns, or queries, please contact aurc@ayaa.com.au or your teams coordinator.

1.2 Submission

You must submit your report as one consolidated PDF file through the submission portal on the AURC website (www.aurc.ayaa.com.au/submissions) by 11:59pm AEST, Sunday 31th May 2020. Your file naming convention must follow *Team_X_SIM _Report.pdf* where X is replaced by your team number.

AURC 2020 Further Simulations Marking Rubric						
Subject	**0 Mark**	**3 Marks**	**5 Marks**	**8 Marks**	**10 Marks**	**Total**
Executive Summary	No executive summary provided.	Poor or incomplete overview of the rocket, lack of understanding of the competition category. Unclear project objectives and goals.	Clear, concise and informative overview of the rocket and competition category, the project's objectives and goals. Discloses the project's simulation challenges and the team's recommended approach.	-	-	
Introduction & Conclusion	No introduction and/or conclusion provided.	-	Fails to concisely summarise the project background or outline the purpose of the report. Too long or too brief to accurately capture the contents of the report.	-	Clearly summarises the background of the project and outlines the purpose of the report. Presents an overview of the team and its goals and projected milestones.	
Finite Element Analysis (FEA)	Brief overview of a single FEA package presented. Limited to no benefits and limitations provided. No understanding shown for the selected software's computational methods.	Overview of multiple FEA packages presented. Fewer than 5 benefits and limitations provided for each package. Minimal understanding shown for the selected software's computational methods.	Detailed critical overview of multiple FEA packages presented. At least 5 benefits and limitations provided for each package. Understanding shown for the selected software's computational methods.	-	-	
	Little to no list of components to be analysed presented. Little to no disclosure of loading cases presented for each component presented. No critical thinking shown for selection of components.	Brief list of components to be analysed presented. Brief list of loading cases presented for each component presented. Poor justification of component selection.	List of components to be analysed presented, lacking in significant detail or justification. List of loading cases presented for each component presented, lacking in significant detail or justification. Some critical thinking shown for selection of components.	List of components to be analysed presented, lacking in some detail or justification. Presents FEM of components with little system information. List of loading cases presented for each component presented, lacking in some detail or justification. Demonstrates evidence to justify FEA on selected components, numerical or otherwise.	Comprehensive and justified list of components to be analysed presented. Presents FEM of components with load cases, system constraints and suitable meshing control. Detailed and justified list of loading cases presented for each component presented. Critical thinking shown for selection of components and justifying the FEA (numerical or otherwise), including justification for components not chosen.	
	No or too few assumptions justified for each analysis case planned. Negligible critical thinking shown for how components will behave in reality.	Fewer than 5 assumptions justified for the each analysis case planned, with little to no justification. Poor critical thinking is shown for how components will behave in reality.	Fewer than 5 assumptions or model simplifications are poorly justified for the each analysis case planned. Minimal critical thinking is presented for how components will behave in reality, and how that is reflected in the analysis.	At least 5 assumptions or model simplifications are adequately justified for the each analysis case planned. Critical Thinking shown for how components will react in reality, and how that is reflected in the analysis.	At least 7 assumptions or model simplifications are justified for each analysis case planned. All justifications are well supported and demonstrate an understanding of engineering theory and computational limitations. Significant critical thinking shown for how components will react in reality, and how that is reflected in the analysis.	

Computational Fluid Dynamics (CFD)	Little to no overview of a single CFD package presented. Little to no benefits and limitations are disclosed. .No understanding shown for the selected software's computational methods.	Overview of multiple CFD packages presented. Fewer than 5 benefits and limitations provided for each package. Minimal understanding shown for the selected software's computational methods.	Detailed critical overview of multiple FEA packages presented. At least 5 benefits and limitations provided for each package. Understanding shown for the selected software's computational methods	-	-	
	Little to no list of components to be analysed presented. Little to no disclosure of loading cases presented for each component presented. No critical thinking shown for selection of components.	Brief list of components to be analysed presented. Brief list of loading cases presented for each component presented. Poor justification of component selection.	List of components to be analysed presented, lacking in significant detail or justification. List of loading cases presented for each component presented, lacking in significant detail or justification. Some critical thinking shown for selection of components.	List of components to be analysed presented, lacking in some detail or justification. Presents FEM of components with little system information. List of loading cases presented for each component presented, lacking in some detail or justification. Demonstrates evidence to justify CFD on selected components, numerical or otherwise.	Comprehensive and justified list of components to be analysed presented. Presents FEM of components with load cases and system constraints. Detailed and justified list of loading cases presented for each component presented. Critical thinking shown for selection of components and justifying the CFD (numerical or otherwise), including justification for components not chosen.	
	Negligible justification of the effects of coupling on the results of the simulation is shown. An incomplete list of components which require coupling from different software packaged is presented. No different types of software coupling are discussed.	A lacking justification of the effects of coupling on the results of the simulation is shown. A list of components which require coupling from different software packaged is presented. A single type of software coupling is discussed.	Justification of the effects of coupling on the results of the simulation is shown. A list of components which require coupling from different software packaged is presented. The selected types of software coupling for some components are discussed.	Detailed justification of the effects of coupling on the results of the simulation is shown, with some errors. A list of components which require coupling from different software packaged is presented and justified. Different types of software coupling are discussed for the critical components presented, with the selected method fully justified.	Detailed justification of the effects of coupling on the results of the simulation is shown. A comprehensive list of components which require coupling from different software packaged is presented, with full justification. Different types of software coupling are discussed for the critical components presented, with the selected method fully justified.	
Flight Simulation	Little to no introduction and comparison between the flight simulation software disclosed. Little to no discussion on the benefits and limitations of the software are presented.	Brief overview provided on the comparison between the flight simulation software. Most aspects and features are covered. Mostly discusses with accuracy on the benefits and limitations. At least 4 different benefits and limitations provided.	Critical discussion on the comparison between the flight simulation softwares. All aspects and features are covered demonstrating an understanding of the detail and customisation of the softwares. Accurate discussion on the benefits and limitations. At least 6 different benefits and limitations provided.	-	-	

	Little to no discussion of the software's calculation of the vehicle trajectory. No equations (or references) provided to support the discussion.	Poor discussion and understanding of the software's calculation of the vehicle trajectory. 1 equation (or reference) provided to support the discussion.	Brief overview provided of how the software calculates vehicle trajectory. Overview occasionally lacking in detail. At least 2 equations (or references) are presented to support the discussion.	Detailed overview on how the software calculates the vehicle trajectory. Almost all aspects and software considerations are included with little detail omitted. At least 3 equations (or references) are presented to support the discussion.	Detailed overview on how the software calculates the vehicle trajectory. All aspects and software considerations are included. More than 4 equations (or references) are presented to support the discussion.	
	Little to no sensitivity analysis plan includeed. Little to no detail, methodologies are provided on verification strategies.	Poor presentation of a sensitivity analysis plan. At least 1 verification strategy is briefly or poorly outlined.	Overview provided on a sensitivity analysis plan. Most aspects relevant to maintaining system reliability are included. At least one methodology is satisfactorily provided on a verification strategy.	Detailed overview provided on a sensitivity analysis plan and accounts for all aspects crucial to the system achieving its goals. Infrequently lacking in detail. At least one verification methodology is included and justified in detail.	Detailed sensitivity analysis plan presented, all with justification. All aspects crucial to the system achieving Its goals are included. At least two methodologies are provided on a verification strategy with substaintial amount of detail.	
Formatting	Report is inappropriately set out, has no cover page, and is inconsistent in structure. Report is frequently repetitive. Report styles, headings and subheadings are largely inappropriate in the field of engineering. Tables and figures are not referenced. Formatting errors are frequent (e.g.tables spilling out of the page) Necessary information is inappropriately referenced.	Grammatical issues are few and far between. Occasional spelling errors, or inappropriate Austrlian English spelling is sometimes used Infrequent use of inappropriate terminologies. Occasional disruption to report writing flow, with infrequent use of the active voice and fragmentation of sentences.	Set out of report is of a concise, consistent and logical nature - strongly aligned with common system engineering principles of report writing. Report is not repetitive. Headings, subheadings, etc. are consistent, logical and concise. All tables and figures are reference appropriately. No formatting errors are presented. All necessary information is both internally and externally referenced in a concise, consistent and logical manor.	-	-	
Language	Grammar is frequency inconsistent and of a low and unprofessional standard. Frequent errors in spelling (Australian English). Frequent use of inappropriate terminologies. Report is not concise in either structure or linguistic technique as a whole.	Grammatical issues are few and far between. Occasional spelling errors, or inappropriate Austrlian English spelling is sometimes used Infrequent use of inappropriate terminologies. Occasional disruption to report writing flow, with infrequent use of the active voice and fragmentation of sentences.	Grammar is with little to no fault and also consistent. Spelling is without error. Consistent and appropriate use of terminoligies. Flow of the report is highly professional and uses the active voice as well as has little to no sentence fragmentation.	-	-	