

## **Homework 1**

1. When researching different definitions for modeling, I found a many definition. A few of them include “the art or activity of making three-dimensional models”, “the devising or use of abstract or mathematical models”, and “use (a system, procedure, etc.) as an example to follow or imitate”. These can all be applied to computer and mathematical simulation. For the first definition, while simulation does not always 3D, a model is being made. For the second and third definitions, I feel like that applies to computer and mathematical simulation to the best. When researching different definition for simulations, these were less diverse. Simulations are very rarely not related to mathematics or other computational matters. Some of these definitions include “the production of a computer model of something, especially for the purpose of study”, and “imitation of a situation or process”.
2. The research article I choice was titled "A Matlab-based modeling and simulation package for electric and hybrid electric vehicle design". I put the citation and the link in the end of the document under references section. The steps of a simulation study that I am looking for are:
  - a. Problem formulation
  - b. Setting objectives and project plans
  - c. Model conceptualization
  - d. Data collection
  - e. Model translation
  - f. Verify simulation programs
  - g. Validate model
  - h. Design experiments
  - i. Production run and analysis
  - j. Documentation and reporting
  - k. Implementation

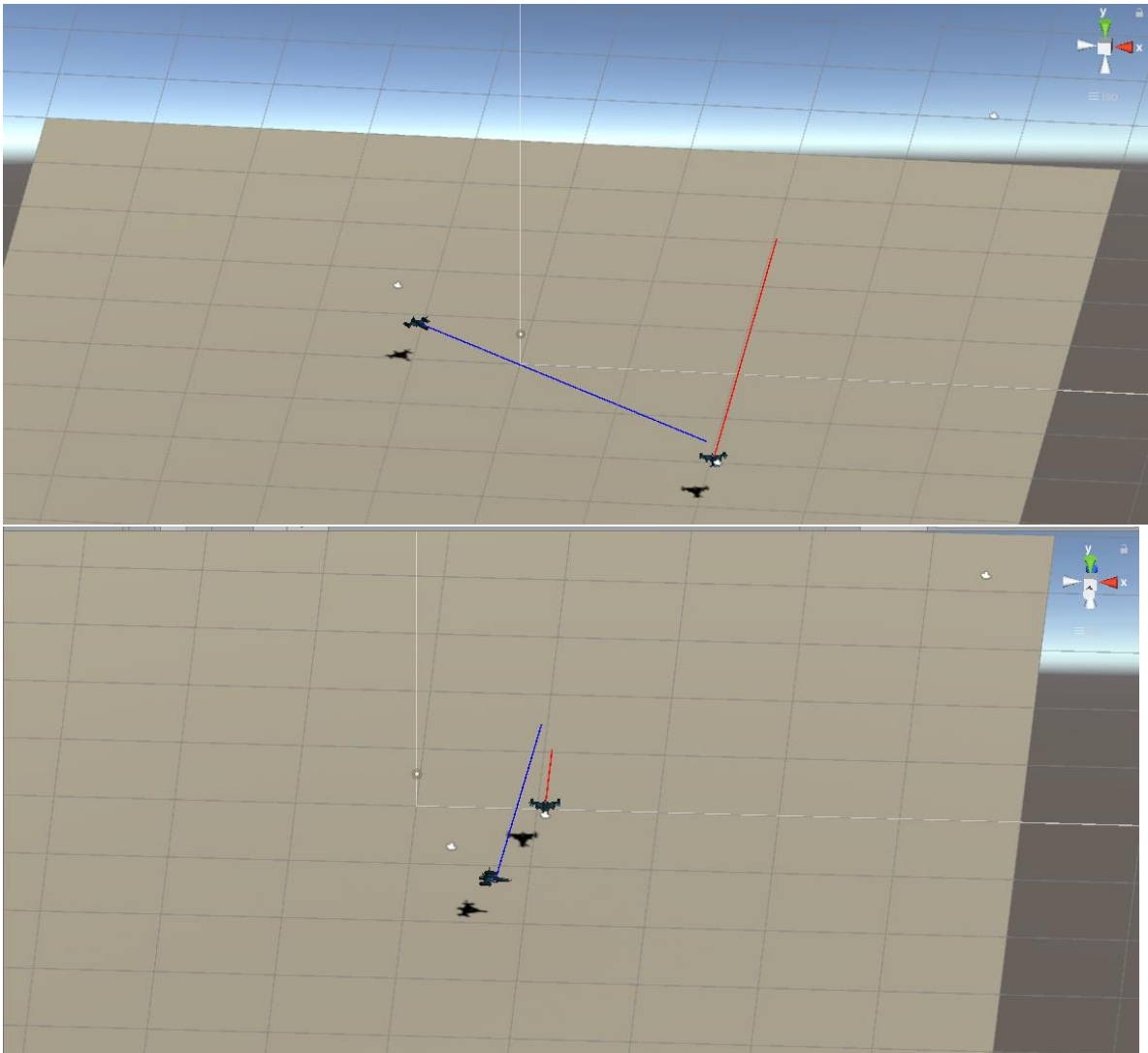
The paper began by talking about the problem of not having a simulation to assess differences between electric cars and hybrid electric cars(a). The objective was to make a program to do that and they laid out the plan to do it in MATLAB(b). It continues on by planning and writing out all the things needed in the model(c). They collected data from different companies to use for this model(d). They went and used the data to plan how they wanted to implement it into MATLAB(e). They then took the model and compared it to the system of a real electric car and hybrid electric car, which proved to be comparable(f/g). Finally, once the simulation was created, they made experiments for it such as testing performance on acceleration, deceleration, cruise(h). They ended by running the experiments, collecting the data, and representing those in graphs, tables, and in text on the article(i/j). This model was implemented and used in many different studies at Texas A&M University(k). This paper hit all the steps required for a simulation study.

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3. For this problem, I used Unity and C# to create the simulation program of two ships, one attacking and one defending. The position and velocity of the attacking ship to predict ahead of time where it thinks the defending ship is heading and goes there. The defending ship starts by going straight until the attack ship is within 2000 units of distance. At this point, every two seconds it will do one of four things. Its first option is to turn left 45 degrees, second is to not turn at all, third is to turn right 45 degrees, and the fourth is to get the rotation of the ship plus 45 degrees and go there. I did this randomness to simulate a pilot trying to shake off the attacker similar to real aerial battle. If this was not in place, eventually the defending ship go in a straight line and the attacking ship would follow forever. This change added some variety in cases. This is a screenshot of the expected courses of each ship, with blue being attacking ship and red being the defending ship.



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### References

Butler, Karen L., Mehrdad Ehsani, and Preyas Kamath. "A Matlab-based modeling and simulation package for electric and hybrid electric vehicle design." *IEEE Transactions on vehicular technology* 48.6 (1999): 1770-1778.

[https://d1wqtxts1xzle7.cloudfront.net/3460971/007\\_Butler\\_Ehsani\\_Kamath.pdf?response-content-disposition=inline%3B+filename%3DA\\_Matlab\\_Based\\_Modeling\\_and\\_Simulation\\_P.pdf&Expires=1611614768&Signature=eqvntXcGL5m4-bJubyPdf1vKpifyfzwOykBx80ZGYO0wxkdMydq1J09OY9FZO~GzxxH-dbRFf5XbFYkYtOJBpNwT~xz1EN3BGh7d03zncyEukVYhVaNHr~32vZtosEvlpfn3TdbfxcStQNaBf849qNbZReXiFe62pgPBFAbg2tQQ1YGJtesYwuRHcNYgwdnrCern-kR0Nk9w1XykyFQXBcX22-wMLD~TxiMMKk~3voqi8yGHDDDI8pk33hEld7fRwm-yg9FsQ5sHjVKNpWHhpsyEOYb67r3Vtzd62pLtNTi59xQ6wHnHyJ3fSeyqg5-l5mjHcgGcb-HUGeLGAqWMbg\\_&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA](https://d1wqtxts1xzle7.cloudfront.net/3460971/007_Butler_Ehsani_Kamath.pdf?response-content-disposition=inline%3B+filename%3DA_Matlab_Based_Modeling_and_Simulation_P.pdf&Expires=1611614768&Signature=eqvntXcGL5m4-bJubyPdf1vKpifyfzwOykBx80ZGYO0wxkdMydq1J09OY9FZO~GzxxH-dbRFf5XbFYkYtOJBpNwT~xz1EN3BGh7d03zncyEukVYhVaNHr~32vZtosEvlpfn3TdbfxcStQNaBf849qNbZReXiFe62pgPBFAbg2tQQ1YGJtesYwuRHcNYgwdnrCern-kR0Nk9w1XykyFQXBcX22-wMLD~TxiMMKk~3voqi8yGHDDDI8pk33hEld7fRwm-yg9FsQ5sHjVKNpWHhpsyEOYb67r3Vtzd62pLtNTi59xQ6wHnHyJ3fSeyqg5-l5mjHcgGcb-HUGeLGAqWMbg_&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA)