

Student Checklist (1A)

This form is required for ALL projects.

1. a. Student/Team Leader: _____ Grade: _____
Email: _____ Phone: _____
b. Team Member: _____ c. Team Member: _____
2. Title of Project: _____

3. School: _____ School Phone: _____
School Address: _____

4. Adult Sponsor: _____ Phone/Email: _____
5. Does this project need SRC/IRB/IACUC or other pre-approval? ☐ Yes ☐ No Tentative start date: _____
6. Is this a continuation/progression from a previous year? ☐ Yes ☐ No
If Yes:
a. Attach the previous year's ☐ Abstract **and** ☐ Research Plan/Project Summary
b. Explain how this project is new and different from previous years on
☐ Continuation/Research Progression Form (7)
7. This year's laboratory experiment/data collection:

Actual Start Date: (mm/dd/yy) _____ End Date: (mm/dd/yy) _____
8. Where will you conduct your experimentation? (check all that apply)
☐ Research Institution ☐ School ☐ Field ☐ Home ☐ Other: _____
9. List name and address of all non-home and non-school work site(s):
Name: _____
Address: _____
Phone/
email _____
10. Complete a Research Plan/Project Summary following the Research Plan/Project Summary instructions and attach to this form.
11. An abstract is required for all projects after experimentation.

Research Plan/Project Summary Instructions

A complete Research Plan/Project Summary is required for ALL projects and must accompany Student Checklist (1A).

1. All projects must have a Research Plan/Project Summary
 - a. Written prior to experimentation following the instructions below to detail the rationale, research question(s), methodology, and risk assessment of the proposed research.
 - b. If changes are made during the research, such changes can be added to the original research plan as an addendum, recognizing that some changes may require returning to the IRB or SRC for appropriate review and approvals. If no additional approvals are required, this addendum serves as a project summary to explain research that was conducted.
 - c. If no changes are made from the original research plan, no project summary is required.
2. Some studies, such as an engineering design or mathematics projects, will be less detailed in the initial project plan and will change through the course of research. If such changes occur, a project summary that explains what was done is required and can be appended to the original research plan.
3. The Research Plan/Project Summary should include the following:
 - a. **RATIONALE:** Include a brief synopsis of the background that supports your research problem and explain why this research is important and if applicable, explain any societal impact of your research.
 - b. **RESEARCH QUESTION(S), HYPOTHESIS(ES), ENGINEERING GOAL(S), EXPECTED OUTCOMES:** How is this based on the rationale described above?
 - c. Describe the following in detail:
 - **Procedures:** Detail all procedures and experimental design including methods for data collection. Describe only your project. Do not include work done by mentor or others.
 - **Risk and Safety:** Identify any potential risks and safety precautions needed.
 - **Data Analysis:** Describe the procedures you will use to analyze the data/results.
 - d. **BIBLIOGRAPHY:** List major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

Items 1–4 below are subject-specific guidelines for additional items to be included in your research plan/project summary as applicable.

1. **Human participants research:**
 - a. **Participants:** Describe age range, gender, racial/ethnic composition of participants. Identify vulnerable populations (minors, pregnant women, prisoners, mentally disabled or economically disadvantaged).
 - b. **Recruitment:** Where will you find your participants? How will they be invited to participate?
 - c. **Methods:** What will participants be asked to do? Will you use any surveys, questionnaires or tests? If yes and not your own, how did you obtain? Did it require permissions? If so, explain. What is the frequency and length of time involved for each subject?
 - d. **Risk Assessment:** What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize risks? List any benefits to society or participants.
 - e. **Protection of Privacy:** Will identifiable information (e.g., names, telephone numbers, birth dates, email addresses) be collected? Will data be confidential/anonymous? If anonymous, describe how the data will be collected. If not anonymous, what procedures are in place for safeguarding confidentiality? Where will data be stored? Who will have access to the data? What will you do with the data after the study?
 - f. **Informed Consent Process:** Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary and they have the right to stop at any time.
2. **Vertebrate animal research:**
 - a. Discuss potential ALTERNATIVES to vertebrate animal use and present justification for use of vertebrates.
 - b. Explain potential impact or contribution of this research.
 - c. Detail all procedures to be used, including methods used to minimize potential discomfort, distress, pain and injury to the animals and detailed chemical concentrations and drug dosages.
 - d. Detail animal numbers, species, strain, sex, age, source, etc., include justification of the numbers planned.
 - e. Describe housing and oversight of daily care
 - f. Discuss disposition of the animals at the termination of the study.
3. **Potentially hazardous biological agents research:**
 - a. Give source of the organism and describe BSL assessment process and BSL determination.
 - b. Detail safety precautions and discuss methods of disposal.
4. **Hazardous chemicals, activities & devices:**
 - Describe Risk Assessment process, supervision, safety precautions and methods of disposal.
 - Material Safety Data Sheets are not necessary to submit with paperwork.

Parameters of Quadratization of Scalar Polynomial ODE's: Research Plan

Foyez Alauddin

In the category of Mathematics

1 Research Question

In my research, we strive to investigate quadratization and its efficiency. The problem we look at is what is the form of a scalar polynomial ODE such that it can be quadratized using exactly 1 new variable.

2 Rationale

Quadratization is a process that allows us to use new variables to reduce a defined scalar polynomial ODE and the Lie derivatives of the new variables into a quadratic form. The reason we strive to do this is because there are already well-established techniques for solving quadratics. Solving such quadratics can aid in finding critical points for optimization, a very important tool in mathematical modeling in science and engineering. Quadratization has been recently used for model dimension reduction in [x]. The idea is that although a quadratized system is larger than the original one, there are more powerful reduction techniques available for quadratic systems.

3 Procedure

My experiment is mostly computer based. I first will test by hand whether it is possible to quadratize using some n^{th} degree scalar polynomial in x using a new variable z that I choose. I will first look to obtain a pattern. I then plan to use a programming software called SageMath to write a program that computes matrices of a matrix using Groebner Bases. What I am essentially doing here is to find linear dependence. Linear dependence is crucial in understanding quadratization as we strive to determine whether the terms present in our scalar polynomial ODE and the Lie derivative of our new variable can be written as a quadratic combination of our new variable and x . The code I use is provided in my paper.

4 Risks and Safety

There are no potential risks as my experimentation relies solely on a computer and hand-written testing.

5 Data Analysis

What the Groebner Basis code will give us are conditions on the coefficients of our defined scalar polynomial ODE. We will analyze conditions to see which coefficients must tend to zero in order for the determinant of our matrices to equal zero. We will then attempt to prove a pattern, if one exists.

6 Bibliography

I primarily used the following links and abstracts to aid in my preliminary knowledge and understanding. I was formally introduced to the idea and process of quadratization by my research mentor Professor Gleb Pogudin. Here are the links that I used:

1. <https://arc.aiaa.org/doi/10.2514/1.J057791>
2. <https://math.berkeley.edu/~bernd/what-is.pdf>