Lab Report Writing

Introductions

- ✓ Moves in Introductions
- ✓ Sample Introduction
- ✓ Introduction Analysis
- ✓ Student Sample Introduction
- ✓ Editing Worksheet

Moves in Introductions

Move 1: Necessary Background Information
Can include:

a. A short statement of phenomenon under study (i.e., what are you studying?)

-or-

b. A statement of importance of phenomenon to the field (brief, 1-2 sentences; i.e., why is this area of research important to engineers?)

-or-

c. A statement of importance of phenomenon to the "real world" (be careful, limit this to a *specific* application or applications. Be brief.)

d. Any necessary background information (e.g., related experiments, etc. that your audience needs to be reminded of. This is more relevant to independent research than to the experiments carried out in this class).

Move 2: Indicate the need for testing/experimental analysis
Can include:

a. A statement of the problem that is being investigated and any subproblems

-or-

b. A question that needs to be answered about the phenomenon under study

Move 3: Show how you will answer the need for testing/experimental analysis
Can include:

a. The method you'll employ to answer the question or solve the problem identified in 2a. (i.e., What are you going to do?)

b. A description of the specific objective of the experiment (i.e., What are you going to do?)

c. A statement of what will be covered in the report (check with individual professors regarding their preferences)

SAMPLE INTRODUCTION
From a NASA Technical Report

Advances in hypersonic vehicle technology have led to the design and fabrication of potential National Aero-space Plan (NASP) fuselage and wing panel structural subcomponents. A hat-stiffened panel is one subcomponent that has been fabricated into two test articles. The first test article was made from monolithic titanium and the other test article was made from titanium matrix composite (TMC). These panels are designed to carry loads both parallel and perpendicular to the hat stiffeners; therefore, the buckling characteristics are critical to their design. Determining these characteristics under a variety of thermal-mechanical test configurations, while maintaining panel integrity, has required the use of innovative test techniques.

Personnel at the National Aeronautics and Space Administration (NASA) Dryden Flight Research Facility (DFRF), in a cooperative effort with the McDonnell Douglas Corp., have completed a thermal-mechanical test program on a monolithic Ti 6Al-4V hat-stiffened panel. This panel was nondestructively tested to 500 °F to examine its buckling characteristics and to validate analytical tools [1]. The test techniques developed to test the monolithic panel recently have been used to test the TMC panel at 500 and 1200 °F in similar thermal-mechanical loading configurations.

Described in this paper are: (1) the test techniques developed to apply the thermal-mechanical loads and minimize boundary effects and (2) the application of a single-strain-gage force/stiffness (*F/S*) buckling prediction technique [2] to the TMC panel. The results contained in this paper show typical experimental data and will not cover every test configuration. In some cases the trends of the results and not the magnitudes are presented because of applicable International Traffic in Arms Regulations (ITAR) restrictions.

Thompson, R.C., and Richards, W.L., "Thermal-Structural Panel Buckling Tests," NASA Technical Memorandum 104243, Dryden Flight Research Facility, NASA, 1991. http://trc.dfrc.nasa.gov/DTRS/1991/PDF/H-1778.pdf. 1/13/03

INTRODUCTION ANALYSIS

Read this excerpt from a NASA report on a fatigue analysis carried out on B-52 mooring hooks, then answer the questions below.

INTRODUCTION

The NASA B-52 carrier aircraft has been used to carry various types of test vehicles for high-altitude drop tests. Test vehicles carried by the B-52 aircraft in the past include X-15, HL-10, highly maneuverable aircraft technology (HiMAT), and drones for aerodynamic and structural testing aircraft (DAST) and the space shuttle solid rocket booster drop test vehicle (SRB-DTV). The test vehicle was attached to the B-52 pylon (airborne launch system) by one front hook and two rear hooks (see fig. 1, in which the store is the SRB-DTV). The B-52 pylon (fig. 2) is almost 30 years old and has been subjected to considerable structural fatigue. Recently, the two rear hooks of the pylon fractured during the towing of the B-52 aircraft carrying the SRB-DTV on a relatively smooth taxiway. During towing, the hook loads were far below the design limit loads. Careful observation of the fracture surfaces of the two failed rear hooks revealed that "micro" surface cracks existed at the rounded inner boundaries of the two failed rear hooks (Ko and Schuster, 1985). This incident raised the serious concern about the remaining fatigue life of the front hook and critical parts of the pylon and also the available fatigue life of the new rear hooks (made of high-performance material and of better design.) Before resuming the new series of SRB-DTV drop tests, it was necessary to conduct proof tests of the pylon by loading it up to specified load limits to establish confidence in the pylon structural integrity. The main purpose of proof tests is as follows. During the proof tests, if some pylon components should fail, then those components are to be replaced. If all the pylon parts survive the proof tests, then fracture mechanics can be applied to estimate the fatigue life (or number of flights left) for each of the critical parts of the pylon based on proof test data and data obtained from the SRB-DTV test flights following the proof tests. This report shows the application of fracture mechanics and the half-cycle method to calculate the remaining fatigue life number of flights left) for each critical component of the pylon carrying the SRB-DTV as a store.

Ko, W.L., Carter, A.L., Totton, W.W., and Ficke, J.M., "Application of Fracture Mechanics and Half-Cycle Method to the Prediction of Fatigue Life of B-52 Aircraft Pylon Components," NASA Technical Memorandum 88277, Dryden Flight Research Facility, NASA, September, 1989. http://trc.dfrc.nasa.gov/DTRS/1989/PDF/H-1383.pdf 1/13/03.

Moves 1, 2 and 3 have been identified for you in this excerpt. Discuss the following questions and refer to the text.

1. Move 1: Do the authors use Move 1a, b, c or d? What kind of necessary background information do the authors supply for the readers?

2. Move 2: How do the authors indicate the need for testing? Circle any key words which contribute to the sense that the research is necessary.

3. Move 3: How do the authors answer the need for testing? Do they use any of the submoves discussed in class, or do they do something else?

SAMPLE STUDENT INTRODUCTION

This introduction comes from a controls experiment. Numbers in margin have been added and should not appear in your reports.

1. Try to identify the moves made by the authors. Label the text.
2. Why do you think they include figures in this introduction?
3. What comments do you have on the way the introduction was ended?

INTRODUCTION

The ability to control a physical system using feedback control is useful in many present and future applications. With this in mind, many engineers have spent a great deal of time trying to understand and construct feedback controllers for dynamic physical systems. Through the use of these feedback systems, computers can detect and correct for errors much faster than humans, allowing development of systems that require split second reactions to function. Cruise control in an automobile is a common example of a feedback control system. The desired speed is compared to the actual speed and the computer actuates the accelerator to make adjustments. Control systems have become an integral part of everyday life, which is why research and development on these systems continues.

The inverted pendulum represents an unstable mechanical system needing to be equipped with a proper control algorithm for stabilization and positioning requirements. Unlike the common "rod on cart" inverted pendulum, where a vertical rod is steered by a horizontally-moving cart attached to its base, the pendulum considered in this experiment consists of a horizontally-sliding rod attached to the top of the vertical rod. The horizontal rod is steered in the presence of gravity to balance and position the vertical rod (see Figure 1.)

Fig. 1

Two rotary optical encoders are used to sense the position and velocity of the vertical rod and the sliding rod. The encoders sense position in discrete increments that are related to the angle and position of the two rods respectively. A description of the overall inverted pendulum apparatus is shown in Figure 2.

Like the rod-on-cart inverted pendulum, the inverted pendulum considered in this experiment is open loop unstable (right half plane poles), and non-minimum phase (right half plane zero). As a result, feedback control is necessary for stability, and the structure of the controller must be chosen carefully. Due to the non-minimum phase characteristics, it is difficult to implement a controller, which only uses the angle sensor as feedback. Because of this, full state feedback control of the pendulum based on a linearized model is implemented which uses both the angle sensor and the sliding rod sensor as feedback.

The aim of this project was to develop a control algorithm that would stabilize the inverted pendulum. This was done using state feedback control of a linear model of the system. The state feedback controller gains were determined by linear quadratic regulator (LQR) synthesis performed in MATLAB.

Fig. 2

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Editing Worksheet
Introductions

Introduction

Area	**Question**	**Y/ N**	**Comments**
Content	1. Does the writer establish identify the phenomenon studied and state its importance to the field of engineering? 2. Does the writer avoid *excessive* discussion of real-world applications? 3. Does the writer clearly state the objectives of the experiment?		
Organization	1. Does the introduction appear to be clearly organized? 2. Does the writer avoid unnecessarily long paragraphs?		
Language	1. Does the writer put old information before new information? 2. Does the writer use concise but specific language? 3. Does the writer avoid mechanical and grammatical errors?		