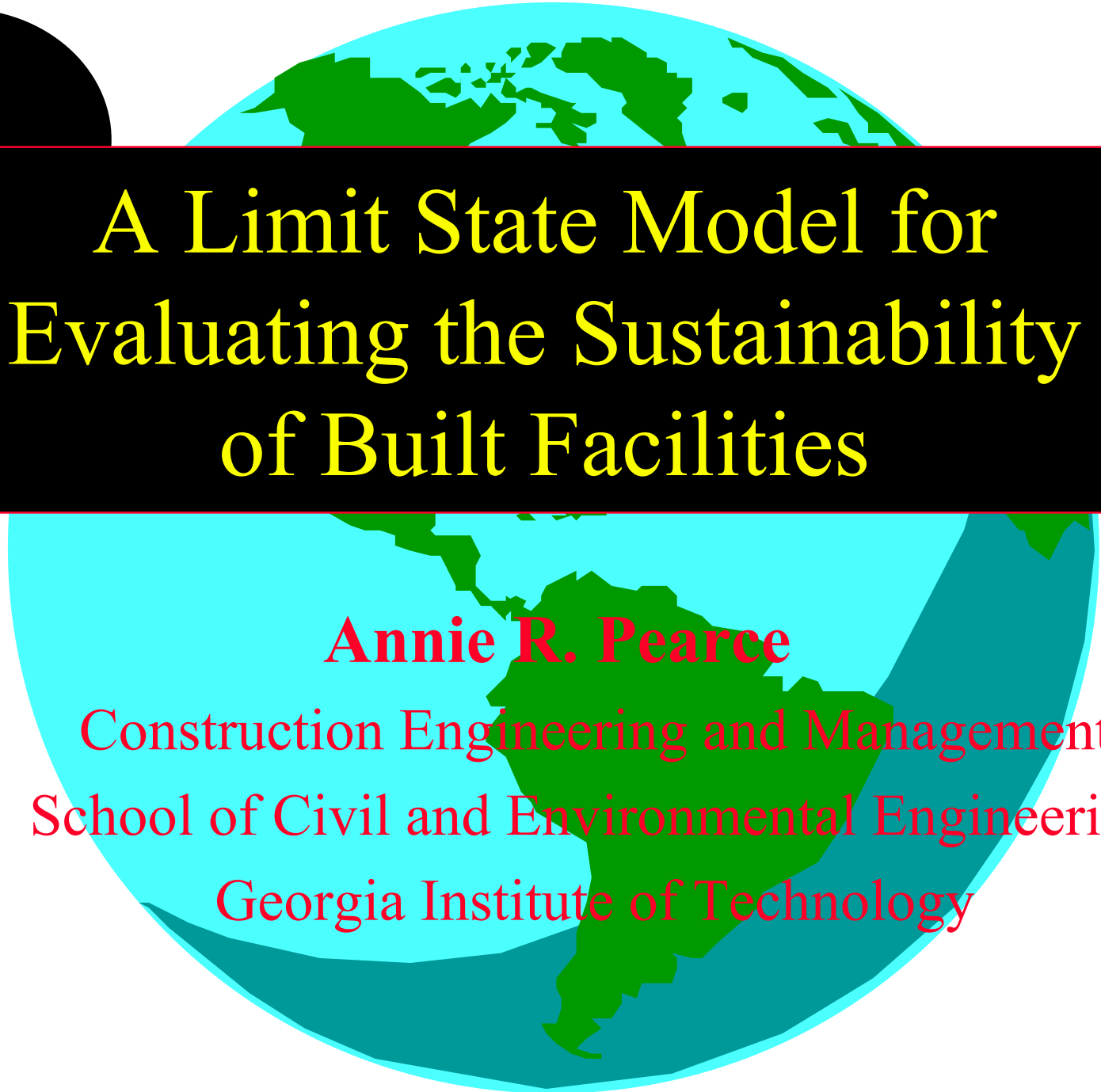

A Limit State Model for Evaluating the Sustainability of Built Facilities

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Objectives

- To present my research problem, solution, and approach
- To encourage informal discussion
- To obtain constructive suggestions
- To establish potential areas of collaboration
- Please ask questions as we go!

Overview

- Problem Statement and Background
- Current Approaches/State of the Art
- The Concept of Sustainability
  - Operational Objectives
  - Limit State Constraints
- The Built Environment
  - Attributes
  - Stakeholders

Overview, cont'd.

- Representing Sustainability of the Built Environment
  - Elements of a Metric
  - Model Representation
- Methodology
- Contributions, Benefits, and Impacts

Problem Statement and Background

- Driver: Stakeholders would like to apply sustainability to built facilities (and other artifacts)
- Problem: How to assess the sustainability of buildings?

Current Approaches/State of the Art

- Theoretical Sustainability Problems:
  - Confusion between issues and strategies
    - Munasinghe's Triangle
    - Daly's Operational Principles
    - The Natural Step
  - Disagreement over strategies
    - Solow's Fungibility
    - Daly's Active Substitution
    - Preservationism

Current Approaches/State of the Art

- Applied Sustainability Approaches:
  - Sustainability as an "Add-on"
    - Principles, Heuristics, and Specifications
  - Paradigm Shift to Sustainable Design:
    - Regenerative Design
    - Ecological Design
- We still don't know how sustainable the resulting products are...

The Concept of Sustainability

- Q1: Can we know how sustainable someTHING is?
- H1: No. We can only predict sustainability, and we don't know if something is sustainable until it proves NOT to be.
- Sustainability as an hypothesis
- Inferential Limit State Approach

The Concept of Sustainability

- Operational Objectives:
  - Minimize consumption of matter and energy
  - Accommodate human needs and aspirations
  - Avoid negative environmental impacts

The Concept of Sustainability

- Limit State Constraints:
  - Consumption =< Sustainable Yield
  - Consumption >= Basic Human Needs
  - Ecosystem Carrying Capacity >= Capacity Required to Sustain Humans

The Built Environment

- How might sustainability apply to buildings?
- What role(s) do buildings play in human sustainability?
- How are buildings different from other artifacts?

The Built Environment

- Attributes:
  - Long life cycles
  - Scale of investment and permanence
  - Foundation for human activities
  - Diversity of facility types
  - Flexibility and multiplicity of uses

The Built Environment

- Who are the people on whom buildings have impacts?
- Stakeholders:
  - Primary/Direct
  - Secondary/Indirect

Representing the Sustainability of the Built Environment

- Elements of a Metric:
  - Parameters for classification
  - Rules for ordering
  - Scaling
  - Absolute zeros

Representing the Sustainability of the Built Environment

- Model Elements:
  - Axes based on limit equations
  - Nexus represents the threshold of sustainability
- Technology/Artifacts/Buildings:
  - Placed into sustainability space based on deviation from threshold (degree of failure)
  - Change over time represented by vector of magnitude > 0

Representing the Sustainability of the Built Environment

- Context determines:
  - Scaling factors and units
  - Origin of Reference Frames
- Objectives of Representation:
  - Context Sensitivity
  - Generalizability
  - Ability to resolve or explain discrepancies in applying sustainability

Summary

- Methodology
- Contributions, Benefits, and Impacts