DAILY EXERCISE ROUTINES
by
Patrick L. Anderson and Michael T. Amoroso
Crew Health Care System (CHeCS)
McDonnell Douglas Space System Company, Space Station Division
1100 Hercules Suite 320
Houston, Texas 77058
Phone (713) 283-6500

OUTLINE
- Introduction
- Problem Description
- Proposed Approaches
- Summary
- Panel Discussion
INTRODUCTION

- Daily exercise and periodic stress testings are required on Space Station.
  - **Exercise Equipment:** Treadmill, Dual Bike, Muscular Output Trainer, and portable exercise equipment.
  - **Physiological Monitors:** Daily - Heart Rate Monitor. Periodic - Blood Pressure Monitor, Electrocardiograph, Metabolic Gas Monitor, and Body Mass Measurement Device.

- The equipment is configured either automatically or manually.
- Data is obtained from the physiological monitors and logged by the system.
- Exercise physiologist monitors data and updates the protocols.
PROBLEM FORMULATION

- Exercise protocols strive to maintain cardio-vascular, and musculo-skeletal systems at levels established by doctors and/or exercise physiologists.

- To provide consistent data during stress testing, it is desirable to maintain physiological levels without exceeding targets.

- Metabolic Gas Monitor data, exercise workload data, and perceived exertion levels from interviews (subjective data) are used to ascertain the physical condition of crew members to determine modifications to protocols.
DAILY EXERCISE ROUTINES
by
Patrick L. Anderson and Michael T. Amoroso
(Continued)

■ PROPOSED APPROACHES

- Daily exercise data and periodic stress test data is collected on-orbit and sent to the ground.
- Exercise protocols are modified based on the analysis of data by an exercise physiologist.
- New exercise protocols are uploaded.
- Crew member executes new protocol.
- During stress testing, step function feedback to exercise equipment is provided to reduce overshoot of target physiological parameters.
DAILY EXERCISE ROUTINES
by
Patrick L. Anderson and Michael T. Amoroso
(Continued)

SUMMARY

- Analysis of exercise data is performed by an expert and utilizes subjective input.
- Equipment control is provided by step functions using time and magnitude as input parameters.

(Opening question for Panel discussion)
Is Fuzzy Logic a viable alternative to the current approach?
Comment: (Berenji) Wherever there is a control problem that experts can define heuristics for the fuzzy rules, it makes sense to model the process using rules and fuzzy logic.

Comment: (Weiss) There is lots of literature available. If you treat system where output is heartrate, you can control heartrate by workload (i.e. adjust bungi cords so that the optimum heart-rate is achieved).