

## AN EXPERT SYSTEM FOR FAULT MANAGEMENT ASSISTANCE ON A SPACE SLEEP EXPERIMENT

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### INTRODUCTION

At the time of the seminal 1969 Brainerd conference it was evident that engineering analysis tools, as well as engineering hardware, were enabling a revolution in systems physiology. The *hot topic* at that time, reflecting the Messianic faith of Carlo Terzuolo in the omnipotence of engineers, was linear control theory. And indeed, in the subsequent two decades the language and the tools of control theory became part of the lexicon of physiology. Frequency response, feedback stability, non-linear identification, and computer simulation became so entrenched in the systems physiology field that their origins were no longer worth mentioning. The new *hot topic* for physiology became Artificial Intelligence, including learning systems, neural networks, and expert systems.

Our own interests, in MIT's Man-Vehicle Laboratory, evolved from modeling of vestibular and oculomotor function, which was described in Brainerd, to the use of the weightless conditions of space flight for investigation of human spatial orientation. In order to help in the astronaut performance of challenging experiments in space we began to use expert systems for the in-flight guidance of these willing but insufficiently trained surrogate investigators. Principal Investigators can rarely accompany their experiments into space, and ground-to-air contact with the astronauts performing the experiment is not always possible. Consequently, in a typical space flight, astronauts are faced with learning a large number of scientific experiments, in addition to the flight operational procedures. One way to approach both these problems is by provision of a computer decision aid, such as an expert system, to help guide the operator in real time. This paper presents our recent research in the use of such an expert system in the pursuit of a better way of performing space flight experiments.

#### *Background.*

Previous studies have sought to assess the value of expert systems and other computer aids in fault management situations. An expert system designed as a prosthesis was studied by Roth, Bennett and Woods (8). A more controlled study of a computer decision aid for both forced-pace and subject-paced context-independent fault

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