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Design of Shape Memory Alloy (SMA) Actuators

Springer

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Preface

Shape memory alloys have been fascinating to designers, architects, and researchers in the past decade. There is something about the uncanny ability of seemingly inanimate wires suddenly reacting to external nonmechanical stimulus that evokes curiosity and childlike fascination in everyone. However, commercial applications (other than in the medical field) has been slow. Part of the reason is the lack of accessible explanations that allow people with only basic exposure to such materials to carry out designs that are viable.

Too often, papers and books written (many by the authors themselves) about arcane aspects of SMA behavior are not meant for designers. This leads to exasperation from a designer who wants us to "tell me how do I design with this?"

This book seeks to provide an accessible account of SMA behavior together with examples of preliminary design methodology to students with a basic undergraduate background. The aim is to provide an "on ramp" to explore the unique properties of these devices, and so the book only deals with the "bare necessities" and ignores many nuances including important issues of functional fatigue. Rather the design recommendations are based on being conservative and making design decisions that will eliminate the need for considering such issues at the expense of not being optimal. Our philosophy in designing with SMA is "robust, repeatable, guaranteed behavior" over "optimal" response.

This monograph is by no means extensive but just an introduction and an invitation to the readers to explore the behavior of these materials. It grew out of a National Science Foundation Grant to develop "strength of materials-like" approaches to shape memory wires and springs. While the current applications at the cutting edge have moved on to tubes, plates, and so on, the commercial availability of wires and springs for common devices has grown quite a bit and this is what we wish to emphasize.

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If a reader gains a qualitative understanding of SMA response together with the ability to do a "first-cut" design by reading this book and is able to go on to explore SMA better, then we have succeeded in achieving our purpose of writing this book.

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