Chapter 5
Design of a Prosthetic Ankle Complex:
A Study in Biomimetic System Design

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ABSTRACT

Nature has, over a large span of geological time, engineered near perfect solutions to most problems humans face today. Motion of the limbs is one such area, and the cutting edge in the development of effective prostheses is biomimetics. Limb prostheses have been used by mankind for the better part of known history, and most of the technology currently available in prosthetics is not exclusively new. However, modern prosthetics either are uncomfortable—and the lack of flexion affects the gait of the patient—or too expensive for a large segment of the populace. This chapter seeks to study the mimicry of physiological systems through the design for an ankle prosthesis that includes a passive damper and mimics the shape and behavior of the natural ankle joint.

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INTRODUCTION

The human body is a near perfect machine evolved over millions of years. The limbs of the body are engineered to withstand the wear and tear inflicted upon it and repair most of the damage that may occur. However, there may be certain etiologies where the repair of the limb is not possible. Under such circumstances the removal of the limb is the preferred option. The amputation of a limb may be the caused by various etiologies with diabetes and trauma being exceedingly common. The absence of a limb may also be the result of congenital defects.

The loss or absence of a limb is one of the most traumatic experiences a person may have to go through. As such, the prosthetic has to not only to deliver renewed functionality which is aesthetically pleasing and features effective cosmesis, but it also should serve to improve the wearer's quality of life by fulfilling his sense of wholeness. In as much, it becomes not just a medical device but takes on the added role of being an emotional comfort.

Taking a look at the history of prostheses, it is seen that the history of prosthetics is tinged with the colours of human development, especially those who have been left with something missing, either by birth, accidents or otherwise. Prosthetics, over time became synonymous with hooks and wooden stumps, worn by reel pirates. While it may have been perfectly feasible for seafarers to have a hook or a wooden stump for a prosthetic owing to the relative lack of resources at sea, the image popularised by Hollywood representations may be an over-reach.

It has been seen that some of the most effective solutions to human problems come from the mimicry of nature. Over the course of millions of years of evolution, nature has engineered near perfect systems to perform various functions and the human body is no exception. Mimicking the physiological foot has long been the goal of medical and engineering professionals for many years. Today, the modern versions of primitive peg leg have emerged, integrating the cutting edge of technology and showing promising visions for the future.