Chapter 5
Conclusion and Outlook

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Self-optimizing mechatronic systems offer capabilities well beyond those of traditional technical systems. They are able to react autonomously to changing system objectives based on an evaluation of their current situation. Their development requires the joint effort of several domains: mechanical engineering, electrical engineering, control engineering, software engineering and mathematics, and their advanced functionality makes self-optimizing mechatronic systems complex a challenge to develop. This challenge is taken up by a custom-tailored development process which is introduced in the accompanying book "Design Methodology for Intelligent Technical Systems" [1].

However, self-optimizing mechatronic systems require high dependability, as they are often used in safety-critical environments or are subject to high demands on availability. In this book, the development process of [1] has been expanded to include methods that enable the developer to guarantee or increase the dependability of a self-optimizing mechatronic system. Guidelines for the selection of these methods is proposed and all necessary selection criteria are given; this should enable the developer to quickly select a suitable method for his or her current engineering problem.

In Chap. 1, self-optimizing mechatronic systems were introduced to the reader. Self-optimization not only offers expanded capabilities, but also poses challenges in particular the challenge of how to ensure the dependability of such systems. Here, we have presented our definition of dependability and its application to self-optimizing systems. A brief introduction to our proposed development process, which is the subject of the accompanying book “Design Methodology for Intelligent Technical Systems” [1], is given. One main challenge arises due to the multidisciplinary approach that is required to develop a self-optimizing system, for which we have also suggested certain coordination strategies to overcome the difficulties inherent here. Throughout this book, several demonstrators were used to exemplify different aspects of self-optimizing systems introduced in the chapters. Among these is the RailCab, a system of innovative rail vehicles that offer individual transport for freight or passengers.

J. Gausemeier et al. (eds.), *Dependability of Self-optimizing Mechatronic Systems*,
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In Chap. 2, we presented the parts of the development process which focus on dependability. Based on the development process, we have presented a methodology which helps the developer of a self-optimizing system ensure its dependability. The information in this chapter should help in deciding whether the system's dependability needs to be increased further and offers methods of doing so.

Chapter 3 presents methods which focus on guaranteeing and improving the dependability of self-optimizing mechatronic systems. These methods cover multiple domains which are involved in the development of these systems. All of the method descriptions follow the same structure in order to facilitate their application. Their goal, the prerequisites, a detailed description of their application and the results are given sequentially for each section. Additionally, the methods contain real-world examples using the demonstrators which were introduced in Chap. 1. Each method also contains the necessary criteria.

In Chap. 4, we apply the methodology and the methods presented in Chaps. 2 and 3 to the RailCab. We have improved parts of the RailCab that did not fulfill dependability requirements using the methods described within this book. The RailCab is now a dependable self-optimizing mechatronic system.

The methods which have been presented in this book were developed in the course of the Collaborative Research Center 614. Methods that do not focus on self-optimizing systems, such as standard methods, are thus outside the scope of this book. They have to be incorporated into the development process presented here while it is being used in the development of new products.

The RailCab system and all other demonstrators used in this book are academic research projects. To fully evaluate the suitability of these methods and the accompanying guidelines, an evaluation based on industrial development processes and the problems arising in that environment might prove worthwhile.

Reference

1. Gausemeier, J., Rammig, F.J., Schäfer, W. (eds.): Design Methodology for Intelligent Technical Systems. Lecture Notes in Mechanical Engineering. Springer, Heidelberg (2014), doi:10.1007/978-3-642-45435-6_2