Chapter 7
Conclusion and Future Research Directions

FTC of HS is a hot research topic that intersects two communities of fault diagnosis/tolerance and HS. This book has presented several interesting theories and applications on FTC for HS. It has been shown that both the continuous system theories and DES theories can be applied. This conclusion seems natural since HS consists of continuous and discrete dynamics. However, it deserves to point out that the utilizations of these two main theories in HS field are quite different from that in their own fields.

Due to the special structures and properties of HS, many non-hybrid system FTC methods are unavailable directly for HS. Continuous system theories for non-hybrid systems have to be modified and the switching properties must be taken into account, the difficulty of such work are reflected in Chapters 2-4. DES theories also can not be applied directly. Compared with pure DES, the continuous dynamics of HS have to be considered as indicated in Chapter 5.

There are still many open problems to be further investigated. We shall conclude this book by providing some future research directions, which we hope could be a helpful guide to interested readers when exploring FTC for HS.

1. To consider optimality as a FTC goal besides the continuous stability and the discrete specification. The optimality is very important for the modern systems with considerations for the environment and energy problems. Optimal FTC goal not only requires the stability of the faulty systems but also needs it to be as optimal as possible in spite of faults. Such goal could be potentially achieved by combining the optimal theories of HS [6, 97] and the proposed FTC methods in this book.
2. To relax the constraints about the structure of HS, e.g., consider the stability at non-zero equilibriums. Many HS that are widely used in process control have non-zero equilibriums [83]. On the other hand, the time-variant continuous vector fields as described in [65] also deserve further investigations.

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3. To combine continuous system theories with DES ones such that an integrated fault tolerance framework can be provided with application to real systems. In many real situations, a complex system may have various faults (both continuous and discrete ones) occurring simultaneously. The nondeterministic finite automata model developed in [77] maybe a good tool to address this issue.