Research on Resilience-Oriented Disintegration in System-of-System

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Abstract : The system-of-systems (SoS) are utilized to characterize networks formed by integrating individual complex systems that demonstrate interdependence and interconnectedness. Research on the disintegration issue in SoS is significant in improving network survivability, maintaining network security, and optimizing SoS architecture. Accordingly, this study proposes an integrated framework called resilience-oriented disintegration in SoS (SoSRD), for modeling and solving the issue of SoS disintegration. Firstly, a SoS disintegration index (SoSDI) is presented to evaluate the disintegration effect of SoS. This index provides a practical description of the disintegration process and is the first integration of the network disintegration model and resilience models. Subsequently, we propose a resilience-oriented disintegration method based on reinforcement learning (RDRL) to enhance the efficiency of SoS disintegration. This method is not restricted by the problem scenario as well as considering the coexistence of disintegration (node/link removal) and recovery (node/link addition) during the process of SoS disintegration. Finally, the effectiveness and superiority of the proposed SoSRD are demonstrated through a case study. We demonstrate that our proposed framework outperforms existing indexes and methods in both node and link disintegration scenarios, providing a fresh perspective on network disintegration. The findings provide crucial insights into dismantling harmful SoS and designing a more resilient SoS.

Keywords : system-of-systems, disintegration index, resilience, reinforcement learning

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