Measuring the Impacts of Disruptions on Public Transit Accessibility and Reliability

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Public transit systems are facing higher risk of system degradation from external disruptions, affecting their ability to deliver reliable accessibility to transit users. Therefore, resilience, the ability to maintain functions during a disruption, becomes a crucial assessment of public transit systems. In this paper, we calculate two space-time prism-based measures with General Transit Feed Specification real-time (GTFS-RT) data: realizable real-time accessibility, a conservative real-time accessibility measure that can be achieved by users subject to delays, and scheduled accessibility, accessibility based on schedule. We also define accessibility unreliability, the deviation between realizable accessibility and scheduled accessibility, to measure the reliability of delivered accessibility. We use the two measures to conduct two case studies of short- and long-term disruptions, namely Ohio State football games and the COVID-19 pandemic, on the Central Ohio Transit Authority (COTA) bus system in Columbus, Ohio. We find there are two peaks of high unreliability before and after each football game, with the stadium as the geographic center of the disruption. The after-game peaks are shorter and more intense than the before-game. We also find COVID-19 had persistent negative impacts on accessibility and reliability: Realizable accessibility universally declined during the pandemic, but only part of cities experienced unreliability increase, primarily in urban perimeters and suburbs. Improved traffic conditions during the pandemic may help to reduce unreliability, but the later service cuts increased unreliability. The two case studies prove the effectiveness of the method to detect system disturbances and provide important guidance for public transit system operation and planning.

Keywords: Realizable accessibility; Accessibility reliability; Public transit system; Resilience; Football game; the COVID-19 pandemic.

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