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Time series models for cultural heritage preservation: The case of the Brunelleschi's Dome

Structural Health Monitoring (SHM) of historical heritage is a crucial challenge for preserving humanity's cultural assets. Increasingly, monuments are equipped with multi-sensor monitoring systems that continuously collect large volumes of data over extended periods. These data require the application of appropriate statistical methods to provide meaningful insights into the structural health of such monuments. In this context, we explore the potential of time series models, specifically ARIMA and Structural VAR models, which until now have been used relatively little in the context of static SHM. As a case study, we focus on the Cathedral of Santa Maria del Fiore (Florence). Since the late 15th century, cracks have appeared in its Dome, prompting the initiation of systematic monitoring activities. In 1987, an extensive electronic monitoring system was installed, including numerous deformometers that record crack width variations several times a day. Using ARIMA and Structural VAR models, we investigate the interconnections among cracks and their dynamic responses to exogenous thermal shocks. Our findings reveal a negative relationship between crack width and humidity, consistent patterns between cracks and masonry temperature across the Dome, and novel evidence of differential responses between even and odd webs, as well as between the inner and outer domes.

Special/ Invited session

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