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SPATIAL COMPATIBILITY FILTERS FOR STRUCTURAL HEALTH MONITORING

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Summary: Spatial filters are spatially distributed sensors, which filter a specific content of the deformation or vibration of a structure. Typically, they are put into practice by sensors, which are sensitive to the strain in a deformed structure. The most commonly used type is a modal filter, which filters one specific vibration mode of a structure. Applications of modal filters are in the field of vibration control as well as in Structural Health Monitoring. In the latter context the frequency response function obtained from the modal filter has only a single peak, if the structure is undamaged. If damage occurs, additional peaks appear in the frequency response function, from which one can conclude on the presence of damage. Besides the fact, that using modal filters for Structural Health Monitoring enables damage detection only indirectly, it is also a method, for which detailed information concerning the structure is needed; in particular, the constitutive relations are crucial for the computation of the vibration modes, which are needed to design the modal filters.

In the present paper we propose a different type of spatial filter for Structural Health Monitoring - Spatial Compatibility Filters. Such filters filter the incompatible part of the strain tensor; hence, their signal is trivial, if the strain tensor is comaptible. A non-trivial signal results only from the presence of incompatible parts of the strain tensor, which is the case for damaged structures. Hence, the signal of a compatibility filter can be directly related to damage. Moreover, the design of the filter only requires geometrical information about the structure, but no constitutive relations. Based on the concept of compatibility filters, we discuss their use for different levels of Structural Health Monitoring: Damage detection, localisation and quantification.