University of California, Irvine
Institute for Mathematical Behavioral Sciences
Symmetry and Invariance in the Natural Sciences

Friday and Saturday, November 17 & 18, 2017
Luce Conference Room, SSPA 2112

Symmetry is one of the fundamental concepts in math and physics. It refers to the invariance of systems and phenomena in the presence of transformations. Said more simply, symmetry refers to regularities in nature. This simple definition makes it clear that symmetry is a very general concept because biological, psychological, as well as engineering systems and phenomena are also characterized by regularities. It is universally agreed that without symmetry, science, as we know it, could not exist. Furthermore, the same could be said about all of our arts.

Symmetry and invariance are usually used as synonyms because the same mathematical formalisms can be applied to both concepts. The choice of one of these terms rather than the other seems to depend on the historical conventions operating in individual specialties, as well as on the preferences of the individuals, who talk about symmetry and invariance. One may, however, have a preference for considering symmetry the more general concept because symmetry often includes the concept of redundancy, invariance does not. We call biological and engineering objects "symmetrical" precisely because they are characterized by redundancy, which means that one part of the object is identical, or at least similar to another part of the same object. This is surely true when we consider the bodies of animals, all of which are mirror symmetrical, plants that are mirror-, rotationally- and/or translationally-symmetrical, as well as man-made objects whose symmetry usually depends on the function they serve. Redundancy can also be present in signals as well as in objects. Redundancy in biological, psychological and engineering signals allows one to compress them and transmit them in a more economical way. Arguably, there is even a more important property inherent in the redundancy of signals, namely, redundancy allows one to derive new invariants when the signals undergo many-to-one and one-to-many mappings, as they always do in visual, auditory and haptic perception.

This workshop will explore all of these many aspects of symmetry as it is used in mathematics, physics, biology, psychology, engineering and philosophy. The ubiquity of symmetry, combined with well-established formalisms to deal with it, make symmetry a particularly good candidate for interdisciplinary interactions and collaborations.