

## Research description

Augmented reality (AR) is a research area and an emerging technology related to the registration of computer generated elements to reality. The artificial elements displayed are directly related to the real objects in the physical world; these elements can be information about an object, instructions about specific actions to be taken or virtual 2D or 3D models. More recently, a variant of AR has been proposed: Spatial Augmented Reality (SAR). Instead of using HMD or video see-through devices to produce the augmented view, it uses one or multiple projectors to overlay the virtual information directly *onto* the physical object.

SAR provides advantages over traditional AR: it prevents isolating the user from others and strengthens the feeling that everything happens in the “real” world even though virtual information is involved. Because SAR involves using tangible projection supports, it does not require artificial haptic feedback to create a tactile experience.

In this research project, we are mainly interested in exploring the ways in which the virtual elements can be manipulated given the boundaries of the projection supports (*i.e.* tangible objects). Especially, we would be interested in using SAR to project and edit the appearance of physical objects directly on them instead of having to use dedicated 3D CAD software at every step of the process. We want to study the different ways in which a user could interact with projected information on non-planar surfaces, especially when the operations should be relatively precise. Manipulation of a virtual element can take many forms: changing the appearance of the object, its texture, its shape, its behavior. The application fields can be manifold: object design, interactive exhibitions in museums, tabletop gaming among others.

Some questions:

- Should the manipulation be direct, indirect? Are there cases where one type of manipulation is to be favored over the others (*e.g.* is indirect manipulation more suited when projecting on organically shaped objects)?
- What importance has the tangible aspect in the different application cases; editing, reviewing, gaming?
- Can we use generic objects for projection support or should they be as specialized as possible? What are the pros/cons of using generic projection supports vs. specialized ones?
- When modifying the appearance of an object and especially texture, is there an important conflict between the visual and tactile feedback? Does conflicting feedback hinder the experience of the user?
- Would it be possible to give the illusion of an altered shaped object using projection?