

# Weight Sensation in Virtual Environments Using a Haptic Device with Air Jets

**ABSTRACT:** The research presented in this paper is the design and implementation of a force feedback hand master called AirGlove. The device uses six ports arranged in a Cartesian coordinate frame setting to apply a point force to the user's hand. Compressed air is exhausted through the ports, creating thrust forces. The magnitude and direction of the resultant force are controlled by changing the flow rate of the air jets and by activating different ports. The AirGlove can apply an arbitrary point force to the user's hand. However, the main goal of this research is to reflect gravitational forces to the user so that sensation of weight of a virtual object can be created. After introduction of the main concept of the AirGlove, the paper presents design and implementation details of the device. Integration of the AirGlove with a virtual assembly system called VADE is explained next. Finally, details of experiments with the device are presented and discussed. Results indicate that users wearing the AirGlove can feel a minimum mass of about 100 grams ( $\sim 1\text{N}$  weight) and the device can create a fairly realistic weight sensation.