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Investigating the potential of human echolocation in virtual sonic trigonometry

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Describing a mathematical problem often involves visual diagrams. For blind students this accentuates the challenges they face. Projects such as LAMBDA have used linear speech and Braille to convey algebraic equations. However, spatial features, for example in trigonometry, are difficult to map to a linear-based system. Traditional tactile methods (e.g. German film) convey simple shapes but need Braille support and speech-tactile interfaces (e.g. NOMAD) require unconventional equipment. Cognitive issues regarding tactile interpretation of 3D shapes also persist.
Blind students interact regularly with speech technology and audio games. This exposure means that the auditory system is potentially becoming accustomed to sonic interpretation of computer-based information. Some of our research has looked at expanding the sonic environment to include spatial information aimed at trigonometry. The next stage is to provide interactive user control.
Our system is based on a user interface model in order to consider the cognitive issues involved. We use Microsoft's XNA/XACT environment to create our auditory scene. In this paper we discuss how to implement sonic-based user interaction while further simplifying our auditory scene. In order to achieve this, we examine the potential of human echolocation to orient within the virtual walls and corners of a triangle.