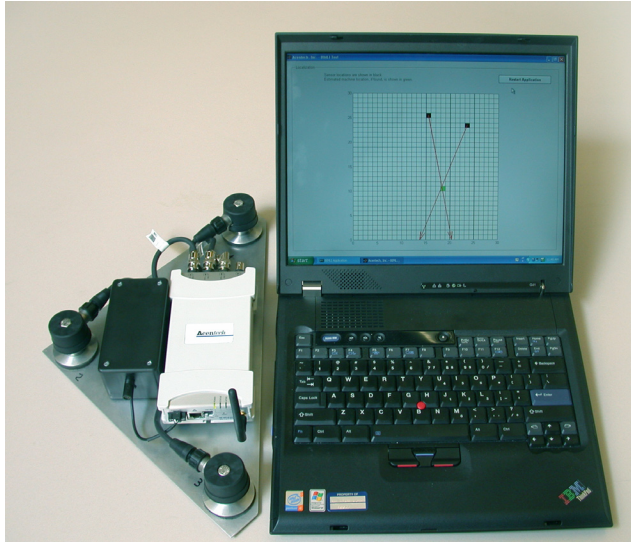


BUILDING INTERROGATION STUDIES

Research for US Army Corps of Engineers



PROJECT DESCRIPTION

Imagine this scenario: a squad of soldiers comes upon a building that may contain power generation, manufacturing, or communications equipment. They would like to know what that equipment might be, and where it is (in the basement, on an upper floor, etc.) prior to entering the building. The Building Interrogation and Machinery Location and Identification (BIMLI) project, supported by the U.S. Army, consisted of a series of studies that culminated in a vibration-based prototype system that detects, classifies and locates a machinery source within a building.

Machinery in a building shakes the floor and walls; sound is radiated away from the building. The frequencies of vibration and their relative strength and phase relationships depend both on the type of machinery and the building characteristics. Acentech's RH Lyon Division developed a way of sensing the vibrations made by internal machinery at the exterior of a building, and then processing these vibration signals to both identify and locate the machinery.

The system we developed makes use of vibration signals that are wirelessly transmitted to a base notebook computer from a triangular 3-element accelerometer array designed for mounting on an exterior wall surface. Detection and identification are first performed using a custom developed classification approach based on an extensive library of machine vibration signatures. If an operating machine is detected, then localization is performed to determine an overall direction of vibrational energy flow based on phase delays calculated between the "horizontal" and "vertical" sensor pairs - an approach that takes into account distortions imposed onto the vibration signals by wall and floor constructions. Moving the sensor array to a second position on the wall enables the source to be located via triangularization of the two calculated wave directions.

The need that the armed forces have to carry out military actions in urban and populated areas is growing. This project is one example of the ways that technology can support our troops as they carry out their missions.

Acentech

CONSULTING SERVICES

- Vibration analysis
- Machinery diagnostics
- Algorithm development
- Measurement system integration



Scale model of a building with vibration source and measurement sensing equipment.



Our tests involved placing vibration sensors on the exterior of a building. Vibration sources were placed at several locations within the building.