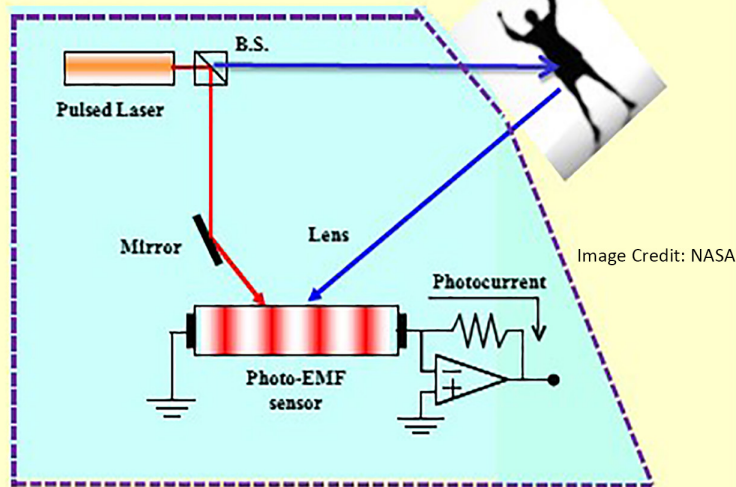
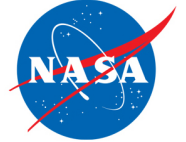


## Photo-EMF Pulsed Laser Vibrometer (PPLV)



National Aeronautics and  
Space Administration



## TECHNOLOGY SOLUTION

### Instrumentation

## Remote, Noninvasive, Cardiac Activity Tracer (RENCAT)

Pulsed laser based highly sensitive vibrometer for measuring minute vibrations

NASA Langley Research Center has developed a novel laser vibrometer sensor for monitoring cardiac activities remotely and non-invasively, specifically heart functions of valve/chamber opening and closing cycles (cardiac cycles). The device provides precise magnitude and timing information, noninvasively and away from the heart region without interference by patient garments.

### BENEFITS

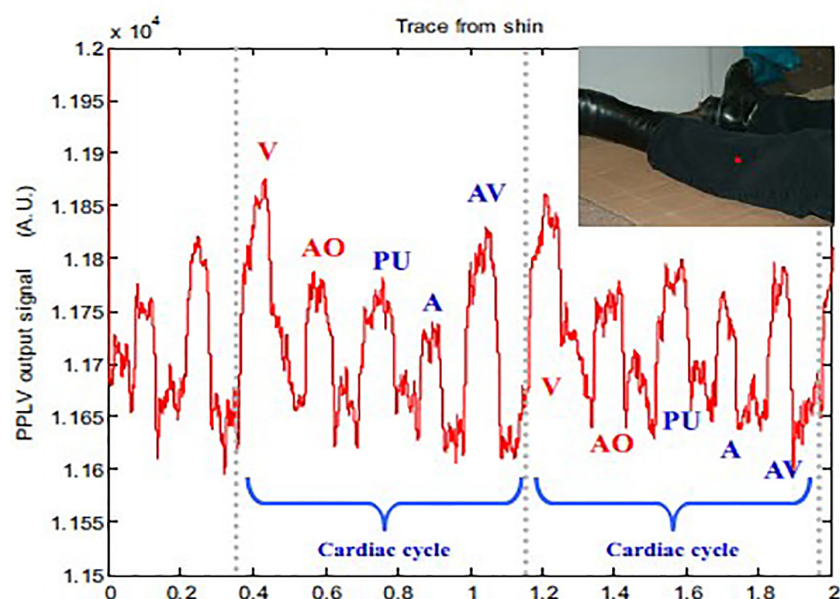
- Can be made portable and hand held suitable for medical applications
- Non-invasive and remote monitoring of cardiac activity
- Can be adapted to a broad variety of other vibration detection applications
- Capable of measuring heart valve opening and closing non-intrusively, with garments on and away from the heart region
- Can be miniaturized



## THE TECHNOLOGY

Blood circulation carries vibrations due to heart beat to every part of the body. These vibrations result in minute displacements that are measured by the detector. Defective closures lead to backflow of blood into chambers leading to heart beat slowdown. Displacement strength is indicative of vibration strength which in turn is indicative of heart beat. Weak vibrations at toes, for example, indicate poor circulation of blood as in the case of diabetic issues. Similarly, in other parts of the body, this unit would help in early detection of diabetes and other diseases by noninvasively monitoring blood circulation at various regions of a human body. As such, this unit would detect precursors for diseases. For astronauts and other operatives, this device could remotely provide the status of their cardiac cycles during physical activities.

The device consists of a laser transmitter, photo-EMF detector and interferometric architecture which provides motion detection. Motion detection aids in measuring displacements. There is also a "speckle tolerant" property allowing data to be collected from conformal and rough target surfaces such as garments. Surface preparation is not needed such as in ECG and other cases. The novel Photo-EMF detector will be able to measure displacements of less than 1 pm.



Technology Demonstration output - Image Credit: NASA

## APPLICATIONS

The technology has several potential applications:

- Analysis of induced or involuntary vibrations and spasms in humans
- Breadth analyzer for diagnosis of cancer and other diseases
- Preventive Health Care Sensor
- Sensitive microphone for mine detection
- Chem-Bio detection such as detection of IEDs
- Nondestructive evaluation of materials
- Planetary composition measurements

## PUBLICATIONS

Patent No: 11,119,072