

Goddard Tech 12

Each month the Strategic Partnerships Office will tell the story of a renowned innovator at NASA's Goddard Space Flight Center and how their technological breakthroughs are brought from the labs to our lives. This month features the Hilbert Huang Transform 2 (HHT2), a two dimensional adaptation to the original Hilbert Huang Transform. This 2D analysis software clarifies distorted images and enables enhanced interpreting of images.

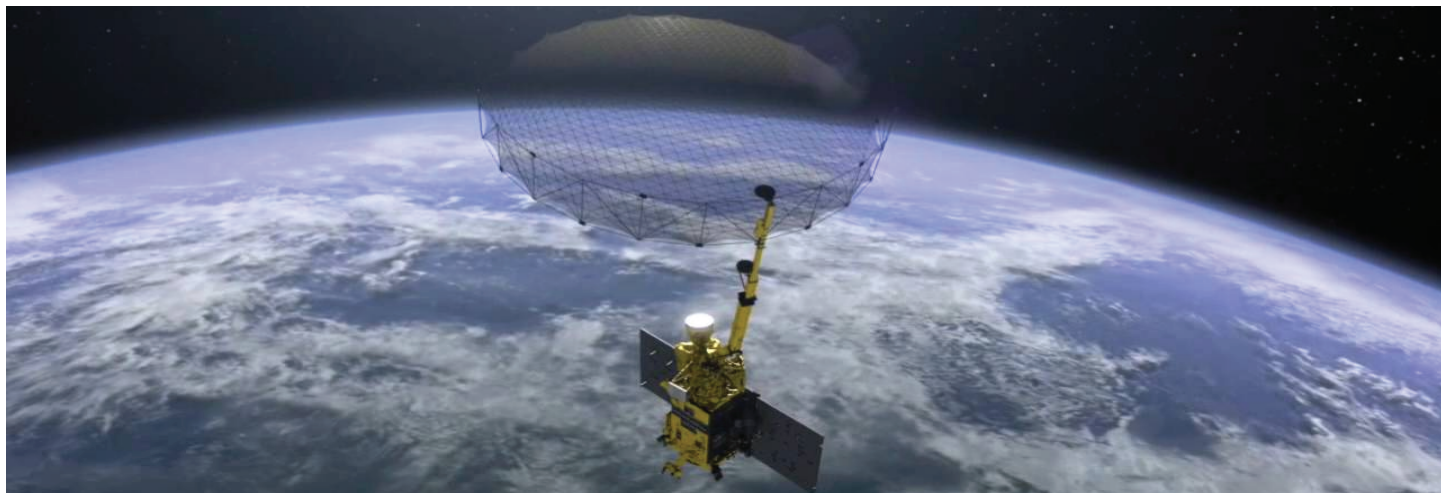


Image Credit: NASA/Caltech

The Technology

HHT2

Aerospace engineer Semion Kizhner will be the first to tell you that understanding transforms is difficult, but he will also tell you that you don't need to understand a transform to use it. Transforms are math formulas that help gather information from complex data sets. With dozens of active missions, NASA is flooded with data and needs the help of transforms to make use of it.

HHT1 worked by analyzing nonstationary signals in one dimension, such as a heartbeat. Kizhner and HHT creator Norden Huang were both interested in applying the Hilbert Huang Transform to the second dimension in order to analyze images. After years of attempts, Kizhner was able to recreate HHT for two dimensional spectral analysis in near real time. Interference in images can be removed with HHT2, which had great benefits to NASA.

Kizhner's first application of HHT2 to a NASA project was implementing the transform to analyze data gathered from a radiometer to fly on the Soil Moisture Active Passive (SMAP) satellite. The radiometer used on SMAP operates in the L1 microwave band, a wavelength unaffected by the atmosphere, to get satellite imagery. This characteristic makes the L1 bandwidth popular for cell phones as well, which often causes interference with the instrument's signals. By using HHT2, the SMAP team recovered data that had been distorted from other signals instead of simply deleting it, which was frequently done before.

The Partnership

Syneren

Semion Kizhner knew the software's image processing had many applications, but felt discovering specific commercial uses was a project better suited for the private sector. Virginia-based high-tech solution provider Syneren Technologies Corporation was up for the challenge. Syneren's owner and CEO, Meg Vootukuru, jumped at the chance to license the powerful HHT2 algorithm, seeing its potential.

Syneren, with Kizhner's consultation, created Syneren Image Enhancing Technology, or SIETech. SIETech uses HHT2 to sift through frequencies in an image, starting with high then moving to lower and lower frequencies, to identify different image features. In a medical application, high frequencies will identify edges in an image, while low frequencies can make distinctions, between a healthy cell and an unhealthy cell.

Mark Christman, Syneren senior program manager, explains the SIETech method very clearly. He states that "the whole process removes periodic noise and other obscurants and lets you see edges, features and patterns you couldn't see otherwise". The software is widely applicable, and almost every industry uses a kind of imaging. Regardless of the industry or type of imaging, this software has the potential to improve the images.

SIETech Applications



National defense: The software can analyze aerial images to distinguish manmade features among foliage, spot footprints or tire tracks, and remove fog or other visual noise



Oil spill crisis management: It could be used to pinpoint areas where the oil is most concentrated, helping to assign resources for oil removal.



HHT2 technology allows for image "noise" to be removed for a clearer picture. Credit: NASA

The Innovator

Semion Kizhner

Before a three and a half decade long career with NASA Goddard, Semion Kizhner led a life filled with perseverance and grit. Born in western Ukraine in 1941, Kizhner is a survivor of the Holocaust. After those life changing events, he saw education as a way to improve his standing in life. He received an undergraduate degree in applied math and cybernetics at Gorky State University in Moscow, Russia. This university happened to be prepping students to work for the space program. A few years after his graduation, Semion made his way to the Eastern United States and to Johns Hopkins University. He completed a five-year master's degree program in computer science in just 22 months and has been at Goddard ever since. In his time, Kizhner has made significant contributions to many NASA missions.