

# 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/Real-Time Data Processing System, from innovator Dr. Norden Huang. This nonlinear and nonstationary signal analyzer is being licensed to DynaDx for numerous applications in the medical industry.

## The Technology

### Hilbert-Huang Transform (HHT)

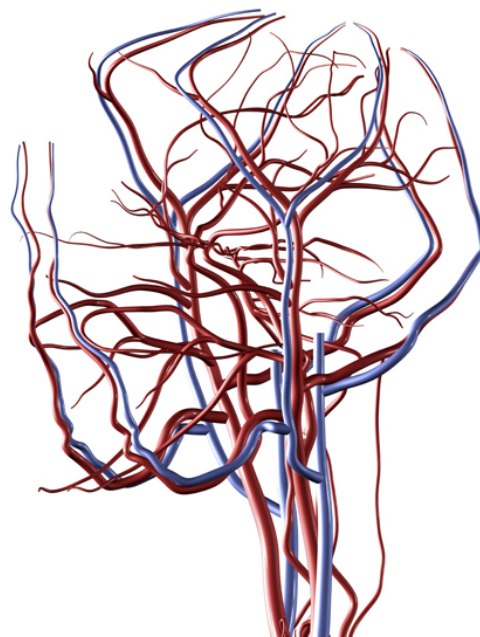
Nonlinear and nonstationary signals are a staple in the medical industry. Our bodies are constantly adjusting to nonstop stimulus. From REM and non REM sleep cycles to heart beat intervals and pressure, there are many irregular signals in our bodies. Dr. Norden Huang saw the importance of measuring the nonstationary. He stated in an interview that "nothing in the universe is stationary. If it's stationary you don't have to analyze it." His breakthrough creation of the HHT expanded on the linear Hilbert Transform and allows for meaningful measurements of the nonlinear.

Both versatile and widely applicable, HHT has been cited as one of the most important discoveries in the field of applied mathematics in NASA history. Many derivative algorithms apply HHT technology to specific problems and there is even a NASA developed HHT2.

HHT is used by the Federal Highway Administration to monitor and improve infrastructure.

The algorithm is helping NASA look for new planets and black holes.

HHT also made shuttle missions safer by testing the tiles that insulate shuttles in space.



## Other Applications

- ③ Analyzing wing flutter test for next generation aircrafts
- ③ Earthquake engineering and geophysical exploration
- ③ Examining complex trends in economics and finance industries
- ③ Identifying individuals with speech recordings in forensics examinations

# The Licensing

## DynaDx



Founded in 2005, DynaDx is a technology company with a medical field focus. Their mission is to use dynamic signal analysis

to improve clinical diagnosis and prediction ability. DynaDx is developing products based on physiological signals including blood pressure, respiratory and neuromuscular signals. It's easy to see why DynaDx pursued HHT technology. In the first ever sale of a government owned patent via auction, DynaDx obtained exclusive rights to the Hilbert-Huang Transform. This agreement includes 11 patents of the HHT and its related applications.

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Based on HHT, DynaDx created a process called the Multimodal Pressure-Flow (MMPF). This process analyzes and evaluates auto regulatory systems in the body that are predictors of brain blood flow-related problems.

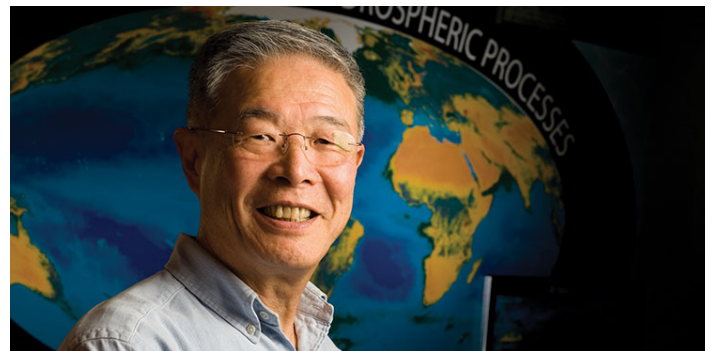
By recognizing that blood flow is not constant, DynaDx was able to create an analysis tool that is superior to traditional methods. This licensing agreement has allowed for medical professionals to know more about brain blood flow disorders such as concussions, strokes and dementia. The transferring of Goddard technologies to the private sector is one way NASA innovations are brought to the public.

# The Innovator






## Norden E. Huang

Huang received a graduate degree in mathematics and fluid mechanics from Johns Hopkins University in 1967. He entered fluid dynamics purely by chance. On his way from Taiwan to the U.S. the ship Huang was on experienced engine failure, causing him to be late to the university. Because of this, all structural and solid mechanic research positions were taken so he became a research assistant in the Gravito-Hydrodynamics Laboratory. His switch to fluid dynamics led to a study of ocean waves for his doctoral thesis and interest in nonlinear signals.

Huang then led a long 30 year career as director of NASA's Goddard Institute of Data Analysis. His educational background led him to research ocean surface waves affected by winds and currents and how those measurements are critical for making better weather and climate forecasts. Taking careful note of the current data analysis shortcomings, Huang developed the HHT, the first adaptive data analysis tool.



## Awards

-  Academician in the Mathematics and Physical Sciences Division of the Academia Sinica
-  Service to America Medal, Science and Environment (2006)
-  NASA Medal for Exceptional Technology Achievement (2005)
-  NASA's Inventor of the Year (2003)
-  NASA's Exceptional Space Act Award (1999, 2002, 2003)