AETA Acoustic & Electromagnetism To AI - Earthquake Prediction System

From 2016, 300 sets have been deployed in some of the most earthquake-active areas in China, of which 240 sets in Sichuan/Yunnan and neighbouring provinces, and 60 sets in other areas. More systems will be deployed as soon as additional funding becomes available. Presently, 38TB of data has been collected, and 20GB of data is being collected daily.

AETA Milestones

2010
Professor Wang Xin'an of Peking University Shenzhen Graduate School, and his team of doctors, began the research of the AETA program, due to two violent earthquakes in China, taking the lives of over 400,000 people.

2013
First lab validation prototype is finished in Peking University Shenzhen Graduate School.

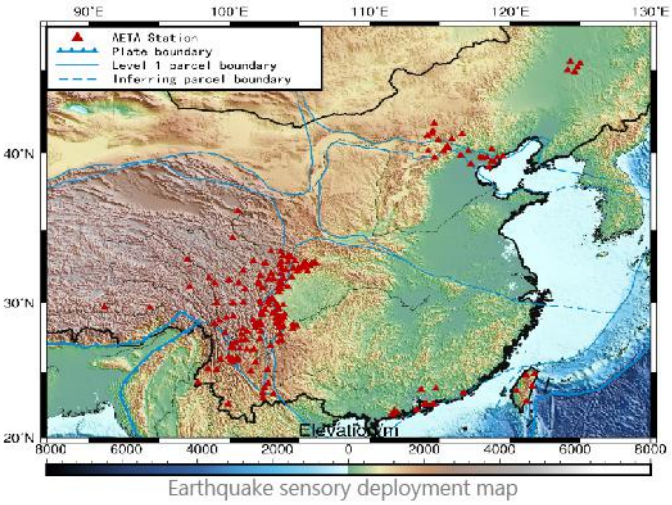
2015
First batch of 20 validation samples were built and deployed in Sichuan, Yunnan, and Hebei. And proved earthquake relevance with geo-acoustic and electromagnetics.

2016
SVV became the hardware partner, by redesigning & improving the sensor's hardware reliability and consistency, and began mass deployment.

2018
Made two earthquake forecasts in Sichuan to the local authorities 3-7 days in advance.

2020
First earthquake prediction AI algorithm competition, with 183 teams, that revealed 10 winners, with average yes/no accuracy above 70%.

2021
Partner with Capgemini's AIE for the second competition to attract international talents and achieve the goal of earthquake forecasting.



Earthquake sensory deployment map

Competition 2020

Materials supplied for competition:

Using past data to train the team's algorithm: Low frequency mean value of geo-acoustic and electromagnetic disturbance from Oct 2016 to Jan 2020.

Real time data for prediction: Low frequency mean value of geo-acoustic and electromagnetic disturbance, provided every Sunday to predict the following week.

List of earthquakes from Oct 2016 to Jan 2020, including epicenter, magnitude, and time.

Competition criteria:

Three major elements teams must test for: Epicenter, magnitude, and accuracy of time.

Prediction of magnitude ≥3.5.

16 week competition, one forecast on every Sunday of the following week, for a total of 16 predictions.

80% of marks on accuracy of epicenter, magnitude, and time. And 20% of marks on defending the algorithm's integrity.

Geographic range for competition: 22~34 north latitude, 98~107 East longitude (Sichuan/Yunnan area where most of the existing sensors are deployed).

Results of 2020 Competition

Champion team (szpianpian): 12 correctness in 16 yes/no predictions (75% correctness), and among the 12 correct predictions, 8 are quite close to expected results, with an average mean deviation of 0.4885 on magnitude, and 103.98 kilometers on the epicenter.

On yes/no forecast, all 10 winners achieved 71% correctness or above, while the current correctness ratio reported in earthquakes is below 20%.

The team from University of Tsukuba even achieved 100% correctness in all 16 yes/no predictions, but unfortunately the accuracy on epicenter and magnitude was not as good compared to the champion team.

AETA - 2021 Competition

Timeline

Promotion and Registration
1-1-2021 to 31-3-2021

Competition
5-4-2021 to 31-10-2021

AIE and AETA

Propose to make the 2021 competition as an example project of AIE.

Peking University Shenzhen Graduate School as project owner, and AIE as the main organizer.

If additional funding is available to support global deployment, AIE would be the ideal partner for data escrow to comply with local data

Leading Professors

Professor Wang Xin'an

Wang Xin'an, Ph.D, Professor and Doctoral supervisor at Peking University. Expert of national key research and development planning. Prof. Wang mainly engages in SoC and integrated microsystems, earthquake monitoring, and prediction technology as well as anti-aging technology of human health. Prof. Wang has published 260+ papers and 3 Books. He has also applied for 190+ patents, 15 of which are international PCT patents, 60 of which are authorized.

Dr. Yong Shanshan

Yong Shanshan, Ph.D., senior engineer at Peking University Shenzhen Graduate School. Dr. Yong mainly engages in SoC and integrated microsystem and earthquake monitoring and prediction technology. Dr. Yong has published 32+ papers. She has also applied for 64+ patents, 16 of which are authorized.

Competition 2021

Materials supplied for competition:

Past data for algorithm training: Complete character values of geo-acoustic and electromagnetic disturbances from Oct-2016 to Dec-2020.

Real time data for prediction: Complete character values of geo-acoustic and electromagnetic disturbances, provided every day for a continuous prediction of the week after from when the competition begins.

List of earthquakes from Oct-2016 to Mar-2021, including epicenter, magnitude and time.

Competition criteria:

Geographic range for competition: 22~34 north latitude, 98~107 East longitude (Sichuan/Yunnan area where most of the existing sensors are deployed).

Three major elements for marking: Epicenter, magnitude, and time accuracy.

Prediction for magnitude ≥3.5.

30 weeks competition, one rolling prediction every day for the following week.

90% of marks on accuracy of epicenter, magnitude, and time, as well as 10% marks on defending the algorithm's integrity.

Goals for 2021 competition:

Have 500+ international teams participate.

≥90% accuracy on yes/no for top 5 teams, with average mean deviation of <0.5 on magnitude and <100 kilometers on epicenter (the density of existing sensors is not enough to support more accurate predictions), and to begin earthquake forecasting for the local authorities by 2021.

Find devoted team members to continue as full-time professionals.

Raise additional funding to deploy more sensors in the competetion area and improve the cometition's accuracy, as well as other earthquake-affected areas e.g., California and Japan, at an ideal density of one system for every 5 kilometers similar to a chessboard's cross joints.

How Does AETA Work?

The multi-component seismic monitoring and prediction system AETA consists of a Geo-acoustic (GA) sensor and electromagnetic (EM) sensor, data processing terminal, cloud platform, and data analysis system. The GA sensor and EM sensor are buried underground and the terminal is placed indoors. Data is then transmitted to the cloud platform via cable network or wireless internet.

The AETA Equipment

Terminal Device

Power Consumption: About 5w;
Weight: 4kg including packing;
Size: Height: 43.1cm, length: 31.7cm, width: 20.3cm;
Port: As the Figure 1 shows;
Fixation: Fixed in the standard cabinet by guide rail, or placed on the desktop.

Acoustic Sensor Probe

Power Consumption: About 3w;
Weight: 11kg including packaging;
Size: Height 9cm, Ellipse long axis 26cm, short axis 16cm;
Interface: Power supply & data transmission integrated network port, and grounding button;
Cable: Armored network cable length: 40m, diameter: 1cm, bending angle greater than 135°
Fixation: Cement covering

Electromagnetic Sensor Probe

Power Consumption: About 3w;
Weight: 16kg including packing;
Size: Height: 92cm, diameter: 35cm;
Port: Power supply & data transmission integrated network port, and grounding button;
Cable: Armored network cable, Length: 40m, diameter: 1cm, bending angle greater than 135°;
Fixation: Cement covering for underground installation, three-legged bracket for cave installation

Installation Process

1. Dig a 2-metres-deep hole at the selected place of deployment.

2. After finishing the 2-meters-deep hole, at the bottom, dig a further 60cm x 50cm x 30cm hole.

3. Then fill this newly dug hole with cement, which will form the foundation bed for the elctromagnetic sensor to be embedded.

4. Place the bottom of the electromagnetic probe into the cement by about 10cm, and keep the probe straight.

5. Place the acoustic probe at least 1 meter beside the electomagnetic probe.

6. Upon completetion of fixing the probes, wait until the cement has solidified and then fill the 2-meter-deep hole with surrounding soil.

7. Place the 2 lines of armored network cables into a PVC pipe, with a diameter of 4 cm. And then lead the line to where the terminal is placed.