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Rapid determination of source parameters in earthquake early warning

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Abstract

In order to effectively reduce the earthquake casualties and property losses, it is particularly important to accurately predict the earthquake and take appropriate protective measures. However, in today's era of rapid development of technology and the increasing seismic capacity of buildings, how to prevent earthquakes more effectively and how to effectively reduce the economic losses caused by earthquakes have become more urgent. Due to the development of real-time strong earthquake monitoring stations and intelligent emergency treatment system, earthquake prediction has become the top priority of government departments and the public. In order to establish an effective earthquake early warning system, it is necessary to quickly and accurately estimate the source parameters of the earthquake, which requires accurate seismic wave recovery and accurate magnitude in 0~5 seconds. In addition to the results need to be updated in real time to ensure accuracy, we need to reduce the error as much as possible, such as less than half a magnitude. Therefore, it is particularly important to obtain the optimal solution of the current moment. This paper will conduct an in-depth study on the composition, function, category and future development trend of earthquake early warning systems at home and abroad, in order to provide effective earthquake relief services for the society. Through comparative analysis, we can clearly see the advantages and disadvantages of different types, so as to better protect the safety of people's lives and property.

Keywords

Focal source parameters; real-time processing; strong shock recording.

1. Foreword

Earthquake is undoubtedly a very destructive natural disaster, Not only will it lead to serious casualties, significant economic losses, And it can cause secondary disasters, Such as fire, flood, earthquake, seismic waves, seismic activity, seismic activity in areas of seismic activity, And the scope of the impact of the earthquake disasters, Their effects on society are ubiquitous, It really hurts to think of it, In particular, Pakistan in 2005, the Indonesian tsunami in 2004, Bam in Iran in 2003, Kobe in Japan in 1995 and the Jiji earthquake in Taiwan in 1999, They further highlight the destructive power of earthquakes, shocker, It is heartbreaking. In China, there are many famous earthquakes, such as the Haiyuan incident in Ningxia in 1920, the Xingtai incident in 1966, and the Tangshan incident in 1976. The damage caused by the earthquake was enormous, and it destroyed many buildings, factories and equipment, as well as the city's infrastructure. In order to minimize casualties and disaster losses, we should take the following three measures: the first is to prevent before the earthquake, the second is to accurately predict the earthquake, and the third is to start emergency rescue immediately after the disaster. In China, a country with underdeveloped economy and imperfect earthquake prediction technology, taking earthquake early warning measures is one of the important means to reduce casualties. By issuing earthquake early warning, we can achieve the following goals: (1) establish a perfect project management system to effectively prevent fire, such as accelerating traffic flow and

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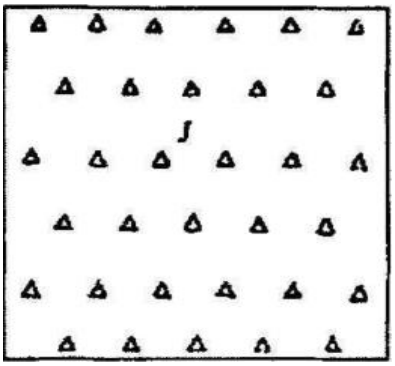
closing down nuclear power plants; (2) timely release earthquake information to relevant departments and the public to remind them to take necessary measures, such as sending rescue workers to the disaster area, or transferring the victims to a safe area; (3) quickly and accurately assess the losses caused by the earthquake. As global climate change intensifies, many countries and regions are trying to develop earthquake early warning systems to cope with the changing environment. Taipei City 2, Mexico City, California and others are actively promoting this technology to meet the needs of fast, accurate and timely earthquake forecasting. Although our country is in the initial stage in the field of earthquake early warning, we still make unremitting efforts to establish an effective technical framework that can quickly identify the earthquake source and effectively prevent it, in order to achieve better disaster prevention effect.

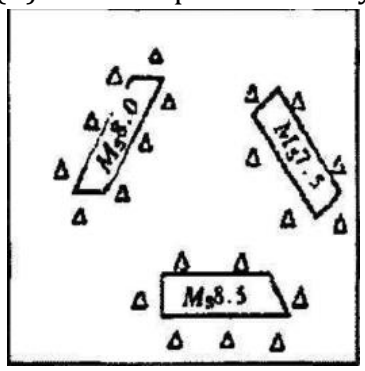
2. Earthquake early-warning system design

2.1. Array

Platform array is a special seismic information receiving and transmission system, it is composed of several platform points, can be arranged according to the characteristics of the warning area, the platform array into the approximate equal spacing network (Figure A), so as to better collect and transmit seismic information. Platform arrays can be used in large areas of a "continuous" population distribution, where resources may be scattered or uniformly random. In densely populated cities, the array can be arranged in a ring , and after the latent source is determined, the array can also be arranged in a ring (Figure B) to better explore and study potential opportunities.



(A) Network platform array



(B) The circular ring array

The arrangement of platform array is very important to improve the accuracy and reliability of earthquake prediction. It can not only receive and process seismic waves quickly, but also effectively carry out seismic phase identification, and provide the basis for further analysis. In order to effectively collect seismic data, we recommend establishing a large number of observations in multiple earthquake areas, so that we can be more accurate and reliable early warning [1].

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2.2. Alarm system

The improved alarm system uses the latest technologies, such as wired or wireless receivers, speakers, optical screens, etc., allowing residents to get more information from the TV. In addition, the alert range can be refined according to different needs, and the precise geographical location can be provided. Using the function of the control center, users can obtain important information about the local disaster, from the epicenter, the theoretical seismic line, the actual location of the area with the intensity exceeding V intensity, to the final arrival countdown, and even hear wonderful field reports. In order to better ensure safety, we can install an automatic switch between the power supply and the TV machine. Once the earthquake alarm is issued, it will automatically open the TV machine, and equipped with a longitude and latitude changer, which can convert the earthquake damage information into the best earthquake forecast according to different signal areas. On the main roads of the city, people can use various forms of warning facilities to remind people around them to pay attention to safety. For example, large billboards, electronic displays, electronic surveillance cameras and so on can send out warning signals. In addition, computers can also issue alarms. However, it is very difficult to install an earthquake warning system at a major transport hub that requires a camera that can automatically locate it. In recent years, due to the wide application of smartphones, the seismic performance of WiFi has been significantly enhanced, therefore, the release of disaster information through smartphones has become a hot topic in earthquake prevention research today.

In order to ensure that people can get timely information about the upcoming earthquake in order to make the right response, we must establish a perfect automatic alarm system, which should not only release information in a timely manner, but also take a variety of ways to spread.

2.3. Control center

The control center is responsible for collecting and analyzing seismic information from the early warning station array, and once a possible disaster is found, it will take immediate action to assess the affected areas and issue a timely alarm. In order to better issue the alarm, the control center adopts a special way: through TV, according to the local viewing frequency, automatically interrupt the local radio and TV programs, so as to timely release the information of the disaster has or upcoming to the victims. Through a variety of channels, such as radio, the Internet and SMS, we can issue timely warnings.

The control center plays a vital role in the early warning system, which can collect and integrate the effective data from the station, in order to accurately evaluate and judge the possible earthquakes, so as to take timely and effective countermeasures. In addition, due to the continuous increase of the data volume, the control center will also timely update it. At present, the biggest challenge is how to quickly and accurately measure the various parameters needed when the earthquake occurs, in order to achieve the timely prediction of disaster [2].

2.4. Automatic control device

When a catastrophic earthquake occurs, in addition to the direct damage caused, it will also cause a variety of secondary disasters, and its influence may be far beyond the scope of the direct damage. For example, on September 1,1923, the Great Kanto earthquake in Japan caused 140,000 casualties, of which more than 50,000 were killed by fire, and the disaster destroyed many streets in Tokyo and Yokohama. By implementing effective early warning and protection measures, we can effectively reduce the losses caused by various natural disasters. In order to prevent the occurrence of earthquake secondary disasters, we must take measures to prevent the overflow of harmful substances in the disaster source, and let the high-speed running system stop running. In order to cope with disasters, we can install advanced automatic control systems on nuclear power plants, gas valves, railways and other important facilities. In the

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event of a catastrophic earthquake, these systems can respond in time and automatically cut off the channels, so as to reduce the impact of secondary disasters.

3. Type of earthquake early warning

3.1. Remote early warning

When an earthquake occurs in an area, its monitoring equipment records the information and transmits it to an unaffected area by electromagnetic waves. In 1868, Cooper first compared the speed of electromagnetic waves to seismic waves, allowing them to be detected before an earthquake struck.

3.2. P-wave early warning

P wave early warning technology is the core principle, when the earthquake, P wave propagation speed faster than S wave, therefore, in the earthquake monitoring equipment can according to the P wave information collected, quickly determine the location of the earthquake, strength and depth, and timely alarm, in order to shorten the warning time, but also lead to warning accuracy affected [3].

3.3. Warning of earthquake parameters

Using P-wave and S-wave technologies, we can more accurately measure the location, depth, and magnitude of the earthquake, and the advantage is that it provides more accurate predictions, but it takes longer than relying solely on P-wave predictions.

3.4. Warning of ground motion value

Through this method, we can detect whether the value of the ground wave and S wave exceeds the preset threshold, but because of its low accuracy, its advantage is that it can shorten the warning time.

4. Epilogue

Through the use of electromagnetic wave spread faster than seismic wave, and seismic P wave propagation faster than S wave and surface wave, earthquake early warning technology in the seismic wave before the target site can timely alert, although this process only short, but it to prevent earthquake disasters, reduce losses, ensure the safety of the public plays a vital role.

Reference documentation

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