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Sensitivity Analysis of Electro-Explosive Devices

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Abstract— The determination of the electro-explosive devices is to be done before using any such devices. For this their stimulus level that is, the optimal current required for any particular EED, is determined with the help of suitable sensitivity tests. This sensitivity test calculates different types of currents. All Fire Current (AFC), No Fire Current (NFC), and Recommended Fire Current (RFC) involved in firing the Electro- Explosive Devices (EEDs). There are four major methods or techniques to do so name as: Bruceton Method, Lang lie Test, Neyer's Method, AD Optimal Method. In order to obtain these three currents, the calculations involving n, Σni, Σni2, mean, median, standard deviation, variance etc. are to be performed which is a very laborious and tedious job, which take even 5-6 hours also. So, the software being developed will be a user friendly and menu driven software which will be able to calculate all three currents very precisely in less than 5 seconds. And the software will process the experimental data and perform all the complicated statistical calculations in order to reduce manual errors to give the optimal results

INTRODUCTION

NEED

Electro-Explosives devices designers are interestedin determining the AFC (All Fire Current), usually it is defined as the amount of shock necessary to cause 99.999 % of explosion.These materialscan be categorized by the speed at which they expand. Materials that explode faster than the speed of sound are said to be "high explosives" and materials that explode slower than the speed of sound are said to be "low explosives". Explosives can bealso categorized by their sensitivity. Sensitive materials that can be initiated by a relatively small amount of pressure orheat are primary explosives and materials that are relatively insensitive are secondary explosives or tertiary explosives.

The safety testing of explosives devices involves the determination of various properties of the different energetic materials that are used in commercial, mining, and in military applications. It is highly desirable to measure the required conditions under which explosives can be set off for several reasons, including: Safety in storage, Safety in handling, Safety in use. The new test based on a known probability response curve. The main advantages over many previously described sensitivity tests, is that if the parameters of the probability distribution are not well known in advance. This procedure has a starting algorithm that quickly produces unique estimates of the parameters, regardless of how close the parameters of the population are to the initial guesses. The main things are that it uses a design motivated by D-optimality considerations for the remaining samples to maximize knowledge of the parameters of the curve. A C-optimal design would allow more precise estimation of one quintile by concentrating the tests near the specified level. The estimate would also be independent of the distribution. The C-optimal design, however, does not efficiently provide knowledge of the form of the whole population (A c-optimal design for estimating quintiles in the tails of a distribution would concentrate tests at two points in the distribution. A D-optimal design provides efficient estimates of the parameters of the distribution. It allows relatively efficient determination of all quintiles of the population, but the estimates are distribution dependent. A D-optimal design in many cases could be of more use to engineers than a c-optimal design, even when the engineer is only interested in one extreme quintile. Suppose if an engineer wants to test new explosive mixtures for greater sensitivity. A c-optimal design should allow the engineer to determine the all-fire level more efficiently than a D-optimal design. The engineer could then restrict future study to mixtures with smaller thresholds. Knowledge of the entire response curve, however, it would allow the experimenter to further investigate potentially promising mixtures. For eg: a mixture with larger all-fire level but smaller scale parameter might give insight into methods of improving process control. And a mixture with lower mean but larger scale parameter might produce a lower all-fire level if the process could be brought under better control.

APPLICATION:

A. EXPLOSIVE WEAPON

In Armyexplosive weapon generally uses high Explosive to project blast or fragmentation from a point of detonation. Explosive weapons can befurther subdivided by their method of manufacture into explosive ordnance and improvised explosive devices (IEDs). Here Sensitivity refers to the ease with which an explosive can be detonated or ignited i.e., the amount and intensity of heat, shock or friction that is required. When the term sensitivity is used, then care must be taken to clarify what kind of sensitivity is under discussion. The relative sensitivity of a given explosive to impact may vary greatly from its sensitivity to heat or friction. Some of the test methods used to determine sensitivity relate to the Friction Sensitivity is expressed in terms of what occurs when a weighted pendulum scrapes across the material .Impact Sensitivity is expressed in terms of the distance through which a standard weight must be dropped onto the material to cause it to explode.

B. EXPLOSIVE ENGINEERING

Characterization andDevelopment of new explosive materials in various forms. Analysis of the physical process of detonation. Explosive generated shock waves and their effects on materials. Safety testing of explosives. Analysis of amount of intensity and engineering of rock blasting for mining.

C. EXPLOSIVE SAFETY

Explosives safety originated as a formal program in the United States in the aftermath of World War I when several ammunition storage areas were destroyed in a series of mishaps. When such things happens our eyes get opened and we take that matter seriously in account and find the various reason behind it.he most serious occurred at Lake Denmark Naval Ammunition storage Depot, New Jersey, in month of July, 1926 when an electrical storm led to fires that caused explosions and widespread destruction. So it is needed to investigate the disaster and determine if similar conditions existed at other ammunition depots. For this purpose Ammunition and Explosives Safety Standards are needed to be set and sensitivity test is used to set these standards for explosives. The scientific data is evaluated which may adjust. Those reviews, standards and approves all explosives site plans for new construction, and conducts worldwide visits tomost of the locations containing title ammunitions. These all are tests and standards are the set on the sensitivity of the electro-explosive devices.

D. APPLICATION INFORMATION

This application is used to find the sensitivity of electro-explosive devices .This software which provides various method to find the sensitivity of the electro-explosive devices. And gives the result in two form AFC (All Fire Current) and NFC (No Fire Current) which we can store in database or in file. This reduces the number of trial need to be done to find the AFC,NFC practically on the device rather by using some of the method we can find the amount of current required by the particular EED and it also reduces the amount of time required for calculation.by using this software we can find the AFC & NFC within few seconds.

BRUCETON TEST

This test provides one way of analyzing sensitivity and sensitiveness tests of explosives as described originally by Dixon and Mood in 1948. Also known by the name “Up and Down Test” or “the staircase method”, this method relies upon two parameters: first is stimulus and second is step size. The stimulus is provided to the sample, and the results noted. If a positive result is noted, then we decrement the stimulus by the step size. If a negative result occurs, then we increases stimulus by step size. The test continues with each sample tested at a stimulus 1 step up or down from the previous stimulus if the previous result was negative or positive. These results are tabulated and analyzed via Bruceton Method, a computation of sums that can be performed by pencil and paper, to provide estimates of the mean and standard deviation. Confidence estimates are also produced. But generally manually calculation took more time so we are building an application .by using this application the amount of time required for calculation is reduced to few milliseconds.

Advantages:it can be implemented using higher level language. Here wedon’t have to find or give upper and lower limit.

LANGLIE TEST

In this test we have to specify the lower and upper stress limit. The first test is conducted at a middle level of the stress limit given. The remaining levels can be found by the prescription given by Lang lie “The general rule for obtaining the (n+1)st stress level, having completed n trials, is to work backward in the test sequence, starting at the nth trial, until a previous trial (call it the pth trial) is found such that there are as many successes as failures in the pth through nth trials. The (n+1)st stress level is then obtained by averaging the nth stress level with the pth stress level. If there exists no previous stress level satisfying the requirement stated above, then the (n+1)st stress level is obtained by averaging the nth stress level with the upper or lower stress limits of the test interval according to whether the nth result was a success or failure.”

Advantage: It reduces the required sample size by using preceding results to determinea new stress levels.

Disadvantage:The random guessing of lower and upper limits at the beginning if the range of guess is wrong at initial phase then whole test fails.

NEYER’S METHOD

This Test is one way to analyze a sensitivity of explosives as described by Neyer’s in the year 1994. This method has replaced the earlier method like ”Up and Down Test” or Bruceton analysis that was devised by Mood and Dixon in 1948 to allow computation with paperand pencil. Samples are tested at various stimulus levels, and the result (no response or response) is noted. This Test guides the experimenter to select the test levels that provide the maximum amount of information. Unlike previous methods that have been developed, the Neyer’s method requires the use of a computer application or program to calculate the test levels. Although not directly related to the designs (updating the plan after each observation) to group-sequential designs (any partition of the experiment to blocks of numerous observations). It uses binary search technique (response) for any generalized linear model and from the univariate case to the treatment of multiple predictors .to the test method, and the likelihood ratio analysis method is often used to analyze the results of tests conducted with the Neyer D-Optimal test. The analysis methods and combined test are commonly known as the Neyer Test.

Advantage:This Test guides the experimenter to select the test levels that provide the maximum amount of information by testing it at various levels and the no response and response is noted. We use Computer calculations forefficiency and accuracy . This method is extended to deal with situations which are not handled by previous algorithms, including extension from fully sequential

AD OPTIMAL METHOD

This Sensitivity tests are used to estimate the parameters associated with latent continuous variables which cannot be measured. For e.g., each specimen has a threshold. The specimen will explode if and only if an applied shock exceeds this value. Since there is no way to determine the threshold of an individual specimen, the only way is to test the specimens at various levels to determine parameters for the EED's. A new test described here produces efficient result of estimating of the parameters of the distribution, even with limited knowledge. The*AD*-Optimal method efficiently characterizes the whole distribution and desired percentiles of any population.

DESIGN INTERFACE
DATABASE

The database like SQL provides a mechanisms for the data to be stored, updated,, retrieved, deleted in an efficient manner. Database provides the capability to the most of the program to store the things permanently in the hard drive. Because most of the program runs dynamically or in primary memory and they result storing capacity is not permanent. And here comes the database concepts which holds the backend part of the software and provide the durability of the data in very efficient manner. And for easy searching and retrieving of the data from the database we use the concept of primary key and foreign key to have efficient storing and the retrieving of the data from database.

IMPLEMENTATION

Fig1.1

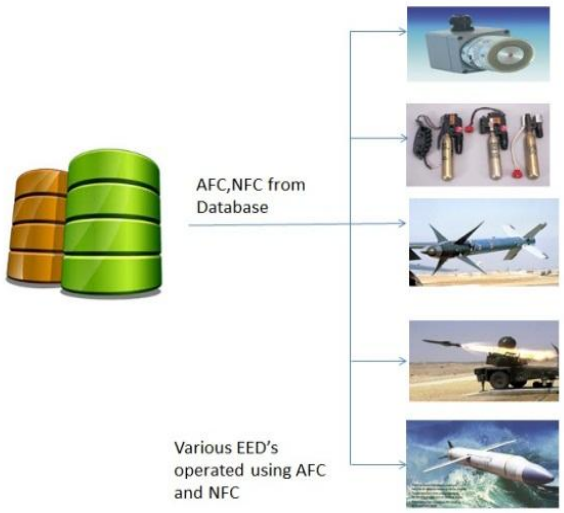

Fig1.2

CONFLICTS OF INTERESTS

We faced major problem in implementing this design. Firstly is that while weare performing stress testing on the application it runs out of memory or gives error the required amount of memory is not Available then we have develop this program using static memory to solve this problem and now it is working efficiently with it.There are two ways to implement it either using linked list or through arrays and both of them have their advantage and disadvantage so according to the purpose we can use whichever we required..

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Here we take input from the file of the reading the tested current values and application provide us the interface and number of test available to perform on that value.

CONCLUSION

We have implemented this application for finding the minimum current (NFC) and maximum current (AFC)required for an EED to fire in exactlin the given rangeor given domain of values computed using software can be computed within few seconds using this software.

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