**10. Outline of Methodology/Experimental Design:**

There are three phases of operation: Sensing,

Triggering and Event Recording. In the Sensing phase, the smartphone will execute

tasks related to sensing of ground vibrations, with the core challenge being ensuring the stability of the phone from ambient noise, prior to data processing. In the Triggering

phase, the algorithm will execute tasks related to detecting the triggering of an

explosion, based on set parameters explained below. Finally, in the Event Recording

phase, the phone will perform tasks related to recording of the explosion event, and

getting ready to sense again.

1. Sensing phase: When device starts running the detection algorithm, this is

the initial phase it enters into. In this phase, the incoming samples of the

accelerometer are processed to ensure the stability. Since the goal of this work

is to demonstrate the feasibility of leveraging static smartphones for detecting

explosions, it is reasonable to conclude that the accelerometer readings sensed

by the sensor in the phone will be stable (due to lack of motion). However,

our experiments revealed something di\_erent. Considering that the phones are

small in form factor and weight, they are quite easy to be displaced even with

minimal amount of external stimuli. Such movement, even though minor can

cause changes in accelerometer readings which can corrupt values sensed under explosion events. As such, we have designed a simplistic model that ensures the

stability of the phone prior to executing our algorithm to make sure that any

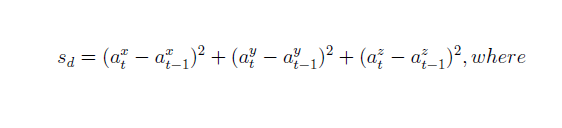
values sensed as a result of ground vibrations during explosions are minimally

corrupted by noise.

As soon as the smartphone starts monitoring, for each sample the algorithm

determines the L2 􀀀 Norm of the di\_erence of acceleration vector from its

previous known to its current sample value.



t: time of arrival of current sample,

t 􀀀 1: time of arrival of previous sample,

at = (axt; ayt ; azt): acceleration vector at time t.

Ideally sd = 0, if the device is absolutely stable, which happens when axt= ax t􀀀1,ayt = ayt􀀀1 and azt = az t􀀀1.

2. Triggering phase: The algorithm will move into this phase after the device is

con\_rmed to be stable. This is phase in which the smartphone detects the

actual triggering of an explosion event if it meets the criteria for the explosion

as discussed below.

The algorithm processes each incoming signal in multiple steps. When an accelerometer

sample is received, each component of the measurement vector x, y,

and z are processed separately. In the \_rst step, the samples x, y, z are corrected

as (x 􀀀 x), (y 􀀀 y), (z 􀀀 z) respectively, using the correction factors evaluated

in the sensing phase to measure the absolute change in acceleration.

Algorithm 1 Pseudocode to Detect Triggering of Explosions

Input: STA Window(STA), LTA Window (LTA), ax, ay, az

Output: Triggering status of the accelerometer samples processed

1: Sensing Phase:

2: while True do

3: Compute sd (as in Equation (6.2))

4: if sd < 0:01 then

5: goto TriggeringPhase

6: end if

7: end while

8:

9: Triggering Phase:

10: x = (x 􀀀 x), y = (y 􀀀 y), z = (z 􀀀 z)

11: Compute Sa, La for time windows STA, LTA

12: if Sa

La

> TRth then

13: goto EventRecordingPhase

14: else

15: Return to TriggeringPhase

16: end if

17:

18: Event Recording Phase:

19: while Sa

La

< DTRth do

20: Add x, y and z into E

21: end while

22: Store E on Phone

23: Return to SensingPhase



Figure 1. Modes of the Smartphone while monitoring for the explosive events