```
% Gunshot data set for the 10 shots fired at President Trump's
% rally in Butler, PA on July 13, 2024
%
% Initial public release: August 9, 2024
% Date of last update:    none
%
% This data was produced by Greg Nichols by carefully analyzing the audio
% tracks and video content of four videos from that day:
%
% 1. Ross!
%    https://www.tmz.com/2024/07/13/trump-rally-gunman-seen-opening-fire-shooting-
gets-killed-new-video-clip/
%
% 2. "He's got a gun", credit TMX
%    https://www.foxnews.com/video/6357914248112
%
% 3. DJ Stewart, extended cut
%    https://youtu.be/28lxF9LONGk?t=285
%
% 4. Broadcast audio from Trump's podium mic
%    https://rumble.com/v56qifh-trump-maga-rally-in-butler-pa-rav-live-team-
coverage.html
%
% Knowing the exact position of the recording sources is an essential
% requirement for being able to perform TDOA analysis. Each of the first
% three videos was carefully examined frame by frame to deduce the position
% as the recording device moved. Sources 1 and 4 were static, but sources 2
% and 3 had a significant amount of movement during the gunshots.
%
% Position data for the four recording sources at each of the ten shots.
% The columns are in UTM format:
% Meters East, meters North and meters of elevation
%
Ross=[
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00;
 586684.00, 4523541.00, 2.00];
%
TMX=[
 586737.52, 4523502.48, 1.00;
 586736.91, 4523505.48, 1.00;
 586734.91, 4523504.48, 1.00;
 586732.96, 4523504.74, 1.00;
 586729.97, 4523506.83, 2.00;
 586727.98, 4523507.91, 2.00;
 586727.98, 4523507.91, 2.00;
 586728.98, 4523508.91, 2.00;
 586726.00, 4523509.00, 2.00;
```

```matlab
  586720.50, 4523514.25, 2.00];
%
DJStew=[
 586775.50, 4523492.00, 0.00;
 586779.00, 4523491.50, 0.00;
 586783.00, 4523491.00, 0.00;
 586791.00, 4523492.00, 0.00;
 586788.00, 4523490.00, 0.00;
 586788.00, 4523490.00, 0.00;
 586788.00, 4523490.00, 0.00;
 586788.00, 4523490.00, 0.00;
 586788.00, 4523490.00, 0.00;
 586771.00, 4523488.00, 1.00];
%
base = 407; %407 meters above sea level
%
Ross(:,3) = Ross(:,3) + base;
TMX(:,3) = TMX(:,3) + base;
DJStew(:,3) = DJStew(:,3) + base;
Podium  = repmat([586731.80, 4523392.44, base+3],10,1);
Shooter = repmat([586768.51, 4523528.24, base+5],10,1);
Second_flr=repmat([586739.47, 4523544.37,base+6],10,1);
north_barn = [586784.00, 4523403.00, base+7];
south_barn = repmat([586771.63, 4523358.59, base+7],10,1);
light_pole = [586724.46, 4523429.46, base+7];
%
c = 351.18; %m/s  speed of sound at 408m altitude and 93°F (33.9°C)
%
%
% These are the times the rifle reports were heard by each mic.
% The times were determined by zooming in to the millisecond level
% and marking the onset of each gunshot at the very leading edge
% of the shot's audio waveform
%
Sources = {'Ross'; 'TMX'; 'DJStew'; 'Podium'};
Report = [
0.000 0.855 1.527 4.307 4.562 4.745 4.921 5.080 5.944 16.016;
0.000 0.853 1.531 4.324 4.580 4.765 4.941 5.100 5.935 16.029;
0.000 0.858 1.538 4.333 4.589 4.773 4.954 5.109 5.874 15.932;
0.000 0.854 1.527 4.310 4.566 4.750 4.930 5.085 5.579 15.591];
%
% The four sources need to be aligned with these steps:
% 1. Choose any one of the 10 shots
% 2. Hypothesize its location
% 3. For all ten shots, calculate the amount of time it would take
%    for the rifle report to arrive at the recording device
% 4. Slide each row left/right to achieve the calculated amount
%    of time offset for the gunshot you chose in step 1
```