

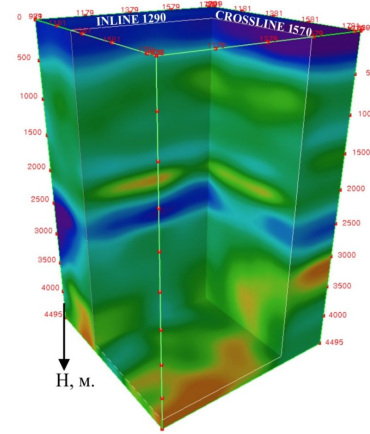
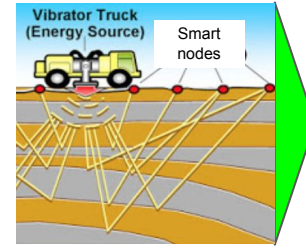
# Design of a Smart Seismic Node

Team: LATEY

# Problem

## *The essence of seismic acquisition:*

- The wave velocity depends on the density of the medium
- The wave is reflected from the interface of the media (densities)
- We are building a geological model of the reservoir
- **The quality of the model determines the further development efficiency**



### Wires



- carry less cargo
- less time to start
- less workforce

### Nodes



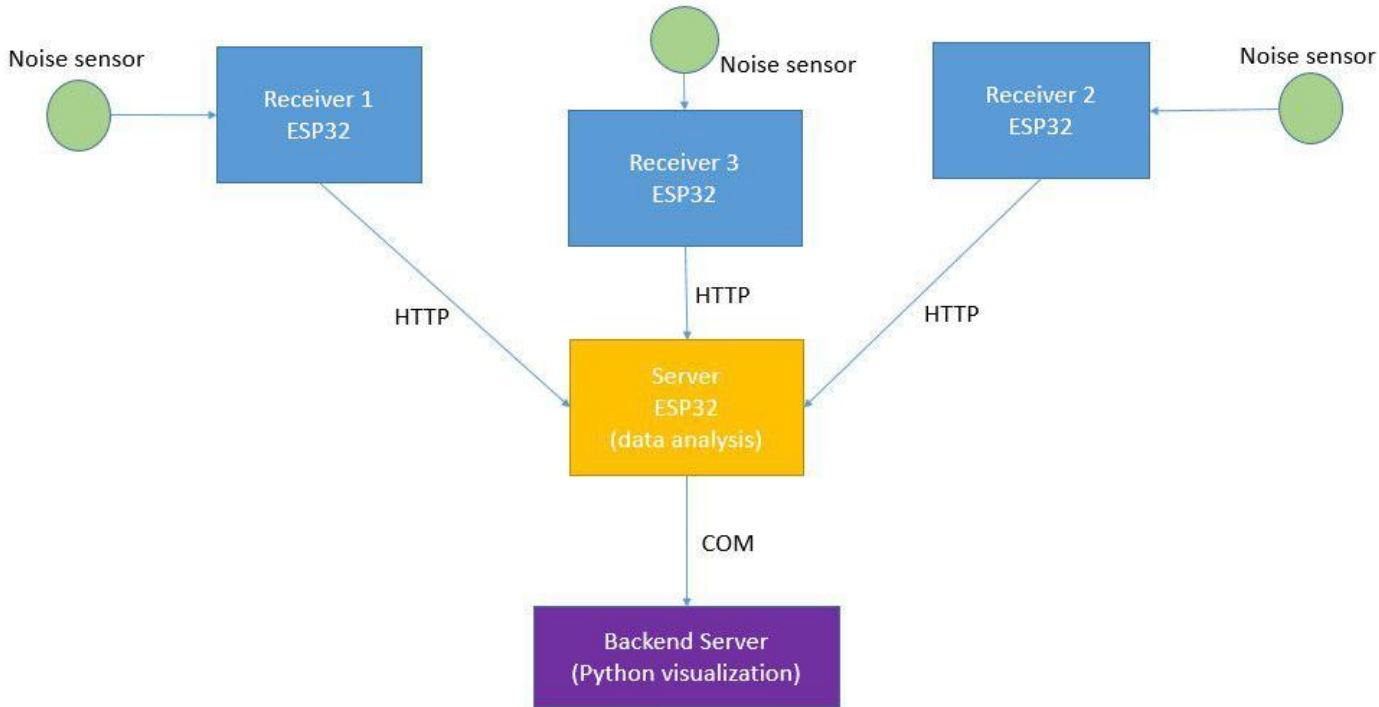
- less data to store
- quick response to failure
- increase accuracy

### Smart nodes

### **Task:**

Using data preprocessing, determine 2 spatial coordinates

# Signal detection



Receiver gets data from the sensor -> preprocessing (error calculation and saving data only above specified loudness threshold) -> send an array of loud data to server -> post processing (calculating the coordinates from given parameters).

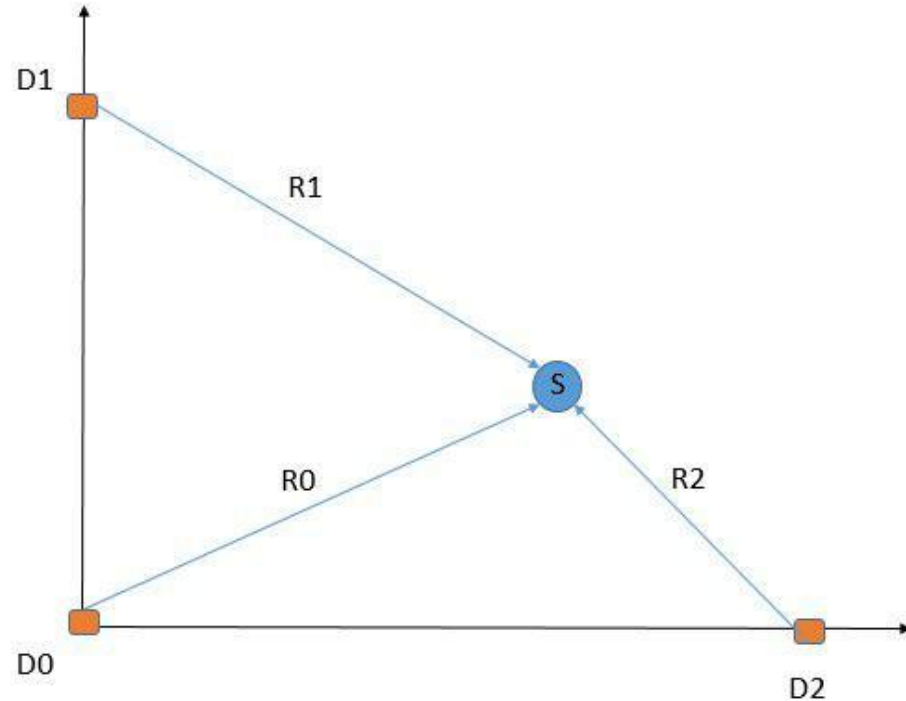
# Source coordinate calculation

- Express delta R in terms of delta T (time difference between signals received).
- Show R in terms of x and y coordinates of the receivers and the source.
- Solve system of equations for source coordinates.
- From 3 points we can solve it 3 times (3 combinations of 3 equations)  
From 5 receivers we can choose 10 times 3 receives.

**=30 coordinates** -> weighted average based on the error of the measurement and receiver location

$$\sqrt{(x - x_0)^2 + (y - y_0)^2} - \sqrt{(x - x_1)^2 + (y - y_1)^2} = dt_{01} v$$

$$\sqrt{(x - x_0)^2 + (y - y_0)^2} - \sqrt{(x - x_2)^2 + (y - y_2)^2} = dt_{02} v$$





+ Code + Text

Copy to Drive

✓ RAM   
Disk 

Editing

```
print(i,j,k)
print(T[i],T[j],T[k])
print(X[i],X[j],X[k])
print(Y[i],Y[j],Y[k])
print(findCoord((T[i]-T[j]), (T[i]-T[k]), (T[j]-T[k]), X[i], Y[i], X[j], Y[j], X[k], Y[k]))
count=count+1

print(count)
```

```
0 1 2
6.1472 6.1483 6.1497
0 0 10
0 10 10
([4.65137427640217, 4.65137427640217, 4.65137427640217], [4.74225652610174, 4.74225652610174, 4.74225652610174])
0 1 3
6.1472 6.1483 6.1291
0 0 10
0 10 0
([9.77727852408418, 9.77727852408418, 9.77727852408418], [4.58543081199484, 4.58543081199484, 4.58543081199484])
0 2 3
6.1472 6.1497 6.1291
0 10 10
0 10 0
([8.21186977025529, 8.21186977025529, 8.21186977025529], [1.04155563343861, 1.04155563343861, 1.04155563343861])
1 2 3
```

# Scalability of the solution

## Size of the problem:

- Detailed work in areas with a complex geological structure
- Big square
- Noizes

## Similar:

- Define useful wave(s)
- Store only “time spots”

## Different:

- Reflections significant
- Medium density isn't constant
- Pre-processing algorithms
- Aggressive environment



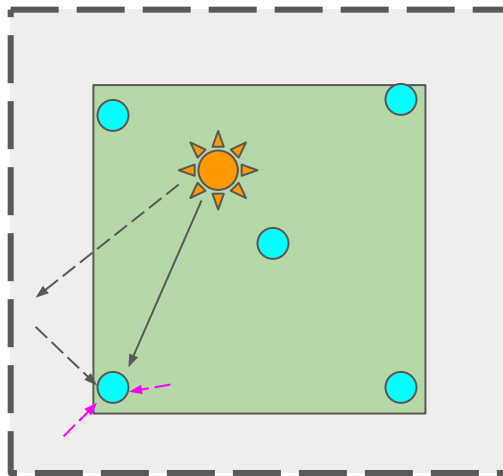
- Improve casing
- Filters to avoid extraneous noise
- Add algorithms ΦΦΦΦΦ

## Steps of digital signal processing:

- Preliminary processing
- Standard processing (obtaining the optimal time section)
- Detailed (full) processing
- Custom processing



*Smart nodes' responsibility from now*



*Solved problem: 10x10 m*

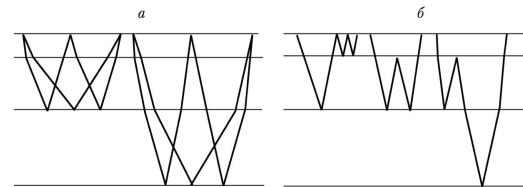


Рис. 4.20. Схема образования полнократных (а) и неполнократных (б) волн

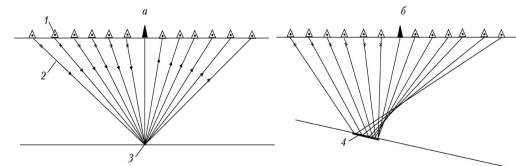


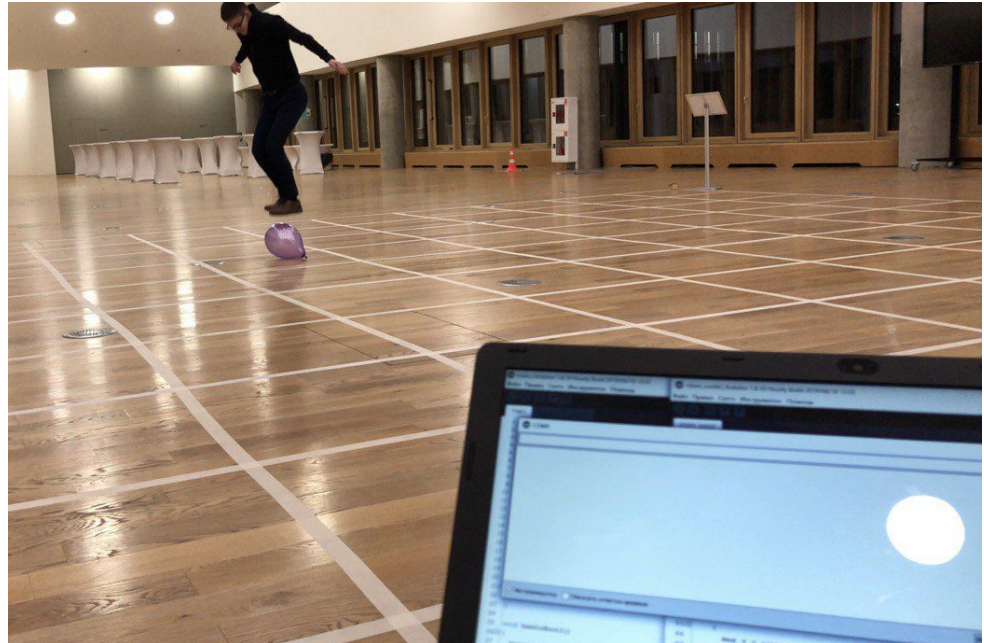
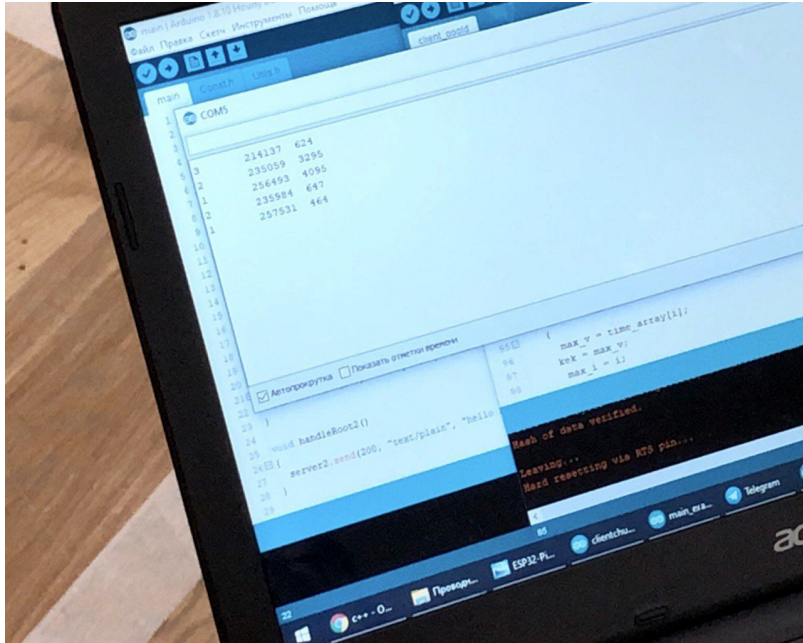
Рис. 4.21. Ход лучей отраженных волн при наблюдениях по методу ОГТ:

а — горизонтальная граница; б — наклонная граница; 1 — приемник; 2 — луч падающей из источника волны; 3 — общая глубинная точка; 4 — общая отражающая площадка

*Real problem 10x10 km*

# Coding part

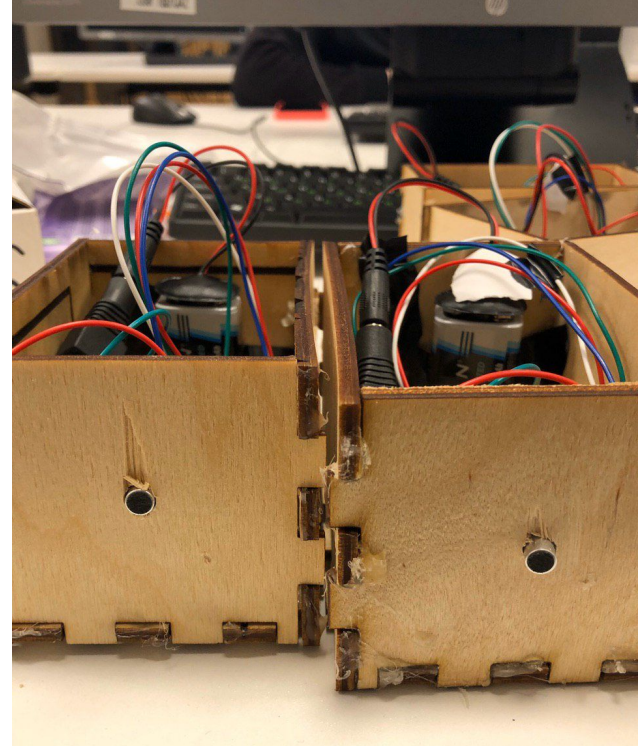
We managed to write a code capable to register incoming noise, create a threshold to work only with a loud ones and transmit this data from client microcontrollers to main server microcontroller. As well as we have a code that returns balloon coordinates when receivers location and time difference (from sensors) of receiver is given





# Device body

We also created wood case for the device for convenient microphone mounting and electronics placement





# Our team

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[https://github.com/YarikineZ/Aramco\\_HACK](https://github.com/YarikineZ/Aramco_HACK)

# Scalability of the solution

Что общего: передаем точки, есть отражения, получаем координату, задаем порог

Что разного: отражения не портят жизнь, от пласта к пласту есть преломления, больше измерений т е 3д, шумы, ослабление сигнала, добавить хранилище

Описание реального процесса (Точнее описать самый сложный варик) - Масштаб и цель задачи (требуемая точность, размер залежи, цель исследования): это может быть поисковый этап, а может быть оч сложное строение ИИИИИ только упругие волны?

Что необходимо будет поменять в алгоритме

Взгляд с тз железа - wifi, зарядка, защищенность, требуемая выч мощность БЕЗОПАСНОСТЬ

Ауткам

гибкость за счет того что провода не нужны