

Project Report

Simulation Of Sound Fields in a Room

reflection_coeff_sequence.cpp

Description:

The program intends to compute and store the values of the reflection coefficient of the reflected ray for a set of reflections in “reflection_coeff_sequence.csv”.

The program took 6 hours to execute for $5 \times 1.0e6$ rays and reflection order = 20.

Program works for 20 reflection orders, meaning it will check if the receiver is detected or not till 20 reflections of the ray. If it fails to detect the receiver, we terminate and move to the next ray.

Modules:

```
1. void add_reflection_coeff_sequence((unsigned long int
   number_of_rays, double radius, vector<vec3> temp_src_pos,
   vector<vec3> temp_img_pos, vector<int>
   temp_reflecting_plane_no, vector<vec3> temp_rp, vector<vec3>
   temp_reflected, vector<double> temp_angle_of_reflection,
   vector<complex_no> temp_Rsurface)
```

Function to add values in reflection_coeff_sequence.csv file

Data Dictionary:

```
1. unsigned int ray_no
```

Variable to run program for every ray

```
2. int r
```

Variable for reflection order loop

```
3. vector<vec3> temp_src_pos
```

Temporary vector to store source positions for each reflection of a ray

```
4. vector<vec3> temp_img_pos
```

Temporary vector to store image positions for each reflection of a ray

```
5. vector<vec3> temp_rp
```

Temporary vector to store positions of reflection point for each reflection of a ray

```
6. vector<vec3> temp_reflected
```

Temporary vector to store direction for each reflection of a ray

```
7. vector<int>temp_reflecting_plane_no
```

Temporary variable to store reflecting plane number for each reflection of ray

8. `vector<double>temp_angle_of_reflection`

Temporary vector to store angle of reflections for each reflection of a ray

9. `vector<complex_no>temp_Rsurface`

Temporary vector to store reflection coefficients for the surface for each reflection of a ray

Pressure_calc.cpp

Description:

The program intends to compute and store the values of the pressure of the ray after successful detection of the ray from the receiver in “pressure_value.csv”.

Modules:

1. `phase_calculate_arg(complex_no value)`

Function to calculate the angle(phase) of complex number passed in the argument

Data Dictionary:

1. `vector<source> s1`

vector to store source position of each reflection

2. `vector<receiver> r1`

vector to store receiver position of each reflection

3. `int source_frequency`

Variable to store frequency of source in hertz

4. `vector<string> row_entry`

Variable to read from file reflection_coeff_sequence.csv

5. `string read_line`

Variable to read from file reflection_coeff_sequence.csv

6. `string read_word`

Variable to read from file reflection_coeff_sequence.csv

Ray_Tracing_Rev3.h

Modules:

1. `phase calculate_arg(complex_no value)`
Ref: used in `pressure_calc.cpp`
2. `void add_reflection_coeff_sequence((unsigned long int
number_of_rays, double radius, vector<vec3> temp_src_pos,
vector<vec3> temp_img_pos, vector<int>
temp_reflecting_plane_no, vector<vec3> temp_rp, vector<vec3>
temp_reflected, vector<double> temp_angle_of_reflection,
vector<complex_no> temp_Rsurface)`
Ref: used in `reflection_coeff_sequence.cpp`

Data Dictionary:

1. `double radian`
Variable to store value of phase in radian
2. `double degree`
Variable to store value of phase in degree
3. `static unsigned long int ray_no`
Variable to store value of ray number
4. `string read_file`
Variable to read from file `reflection_coeff_sequence.csv`
5. `string temp_ray_no`
Variable to read the last ray number from file `reflection_coeff_sequence.csv`

reflection_coeff_sequence.csv

Description:

File stores the value of reflection coefficients of the rays for multiple reflections.

Example:

Columns in the table are:

1. ray_no
2. number_of_rays
3. radius
4. temp_src_pos[i].x
5. temp_src_pos[i].y
6. temp_src_pos[i].z
7. temp_img_pos[i].x
8. temp_img_pos[i].y
9. temp_img_pos[i].z
10. temp_reflecting_plane_no[i]
11. temp_rp[i].x
12. temp_rp[i].y
13. temp_rp[i].z
14. temp_reflected[i].x
15. temp_reflected[i].y
16. temp_reflected[i].z
17. temp_angle_of_reflection[i]
18. temp_Rsurface[i].real
19. temp_Rsurface[i].imaginary

The first 13 rows in the file are for the first ray and the receiver was detected in the 13th reflection. The intermediate data will be used in pressure calculation.

To record data while executing C++ program multiple times, the ray number needs to be updated manually in the program(increment the value of last entry of 1st column)