Spatial Audio toolbox v.1.0

VBAP & VDP

Documentation

1. **Function VBAP_stereophony(theta_zero,theta)**

This function returns the gains for two speakers in stereophony.

- *Input parameters:*

theta_zero – the angle between the central plane and each of the speakers in degrees.
theta – the angle between the sound source and the central plane in degrees.

- **Example**
  - *input:*

```
theta_zero=30;
theta=15;
gains= VBAP_stereophony(theta_zero,theta)
```

  - *output:*

```
gains =    0.9391    0.3437
```

2. **Function VBAP_original(num_speakers,speaker_coord,source_pos)**

This function calculates the gains of each speaker using VBAP and returns them in array.

- *Input parameters:*

num_speakers – number of speakers used MUST BE 3! This parameter is only to show that VBAP uses 3 speakers to pan a sound source
speaker_coord –the coordinates of each speaker in polar coordinate system. The format is following:
speaker_coord(i,1) = 1; % Distance must be in meters
speaker_coord(i,2) = 0; % Azimuth angle of the speaker
speaker_coord(i,3) = 90; % Elevation angle of the speaker
i is the speaker's number.
source_pos – the position of the sound source in polar coordinate system. The format is following:
source_pos(1,1) = 1; % Distance must be in meters
source_pos(1,2) = 45; % Azimuth angle of the source
source_pos(1,3) = 30; % Elevation angle of the source

- **Example**
  - *input:*

```
num_speakers = 3;
speaker_coord(1,1) = 1; % Distance must be in meters
speaker_coord(1,2) = 0; % Azimuth angle
speaker_coord(1,3) = 90; % Elevation angle
```

```
speaker_coord(2,1) = 1; % Distance must be in meters
speaker_coord(2,2) = 0; % Azimuth angle
speaker_coord(2,3) = 0; % Elevation angle

speaker_coord(3,1) = 1; % Distance must be in meters
speaker_coord(3,2) = 41.9; % Azimuth angle
speaker_coord(3,3) = 0; % Elevation angle

source_pos(1,1) = 1; % Distance must be in meters
source_pos(1,2) = 10; % Azimuth angle
source_pos(1,3) = 10; % Elevation angle

sp_gain=VBAP_original(3,speaker_coord,source_pos)
```

- *output:*

```
sp_gain =

   0.5732    0.7148    0.4007
```

3. Function VDPgain_dist(num_speakers,speaker_coord,source_pos)

This function calculates the gains for each speaker using VDP method and returns them in array.

- *Input parameters:*

num_speakers – number of speakers. Here it can be any number, it is not restricted like in VBAP!
speaker_coord –the coordinates of each speaker in polar coordinate system. The format is following:
speaker_coord(i,1) = 1; % Distance must be in meters
speaker_coord(i,2) = 0; % Azimuth angle of the speaker
speaker_coord(i,3) = 90; % Elevation angle of the speaker
i is the speaker's number.
source_pos – the position of the sound source in polar coordinate system. The format is following:
source_pos(1,1) = 1; % Distance must be in meters
source_pos(1,2) = 45; % Azimuth angle of the source
source_pos(1,3) = 30; % Elevation angle of the source

- **Example**

  - *input:*

```
num_speakers = 3;
speaker_coord(1,1) = 1; % Distance must be in meters
speaker_coord(1,2) = 0;
speaker_coord(1,3) = 90;

speaker_coord(2,1) = 1; % Distance must be in meters
speaker_coord(2,2) = 0;
speaker_coord(2,3) = 0;
```

```
speaker_coord(3,1) = 1; % Distance must be in meters
speaker_coord(3,2) = 41.9;
speaker_coord(3,3) = 0;

speaker_coord(4,1) = 1; % Distance must be in meters
speaker_coord(4,2) = 94.6;
speaker_coord(4,3) = 0;


speaker_coord(5,1) = 1; % Distance must be in meters
speaker_coord(5,2) = 150.6;
speaker_coord(5,3) = 0;

speaker_coord(6,1) = 1; % Distance must be in meters
speaker_coord(6,2) = -152.4;
speaker_coord(6,3) = 0;

speaker_coord(7,1) = 1; % Distance must be in meters
speaker_coord(7,2) = -94.5;
speaker_coord(7,3) = 0;

speaker_coord(8,1) = 1; % Distance must be in meters
speaker_coord(8,2) = -44.0;
speaker_coord(8,3) = 0;

speaker_coord(9,1) = 1; % Distance must be in meters
speaker_coord(9,2) = 0;
speaker_coord(9,3) = 28.3;

speaker_coord(10,1) = 1; % Distance must be in meters
speaker_coord(10,2) = 90;
speaker_coord(10,3) = 27.2;

speaker_coord(11,1) = 1; % Distance must be in meters
speaker_coord(11,2) = 180;
speaker_coord(11,3) = 26.7;

speaker_coord(12,1) = 1; % Distance must be in meters
speaker_coord(12,2) = -90;
speaker_coord(12,3) = 27.5;

speaker_coord(13,1) = 1; % Distance must be in meters
speaker_coord(13,2) = -45;
speaker_coord(13,3) = -29;

speaker_coord(14,1) = 1; % Distance must be in meters
speaker_coord(14,2) = 45;
speaker_coord(14,3) = -30;
```

```
speaker_coord(15,1) = 1; % Distance must be in meters
speaker_coord(15,2) = 135;
speaker_coord(15,3) = -25.9;

speaker_coord(16,1) = 1; % Distance must be in meters
speaker_coord(16,2) = -135;
speaker_coord(16,3) = -27.8;

source_pos(1,1) = 1;
source_pos(1,2) = 45;
source_pos(1,3) = 30;

sp_gain= VDPgain_dist(16,speaker_coord,source_pos)
```

- *output:*

```
sp_gain =

Columns 1 through 9

   0.1833    0.2365    0.6778    0.2089    0.0743    0.0502    0.0553    0.0931    0.4096

Columns 10 through 16

   0.4042    0.0693    0.0699    0.0738    0.1833    0.0752    0.0458
```

4. **Function V_delay(num_speakers,speaker_coord,source_pos,fs,SoundSpeed);**

This function returns the delay in samples for each speaker regardless of the method used for calculating gains.

- *Input parameters:*

num_speakers – number of speakers. Here it can be any number, it is not restricted like in VBAP!
speaker_coord – The coordinates of each speaker in polar coordinate system. The format is following:
speaker_coord(i,1) = 1; % Distance must be in meters
speaker_coord(i,2) = 0; % Azimuth angle of the speaker
speaker_coord(i,3) = 90; % Elevation angle of the speaker
i is the speaker's number.
source_pos – the position of the sound source in polar coordinate system. The format is following:
source_pos(1,1) = 1; % Distance must be in meters
source_pos(1,2) = 45; % Azimuth angle of the source
source_pos(1,3) = 30; % Elevation angle of the source
fs – Sample rate
SoundSpeed – The speed of sound

- **Example:**
  - *input:*

```
num_speakers = 3;
speaker_coord(1,1) = 1; % Distance must be in meters
speaker_coord(1,2) = 0; % Azimuth angle
```

```
speaker_coord(1,3) = 90; % Elevation angle

speaker_coord(2,1) = 1; % Distance must be in meters
speaker_coord(2,2) = 0; % Azimuth angle
speaker_coord(2,3) = 0; % Elevation angle

speaker_coord(3,1) = 2; % Distance must be in meters
speaker_coord(3,2) = 41.9; % Azimuth angle
speaker_coord(3,3) = 0; % Elevation angle

source_pos(1,1) = 1; % Distance must be in meters
source_pos(1,2) = 10; % Azimuth angle
source_pos(1,3) = 10; % Elevation angle
fs=44100;
SoundSpeed=340.25;
sp_delay=V_delay(3,speaker_coord,source_pos,fs,SoundSpeed);
```

- *output:*

```
sp_delay =

129.6106  129.6106         0
```

5. **Function Voutputfiles(source_f,f,sp_delay,sp_gain,num_sp,filename);**

This function generates output channels for each speaker from given input wave file. It writes separate wave file for each speaker. The input file should be mono wave file.

- *Input parameters:*

f_source – original mono wave file.
f – Sample rate
sp_delay – array with the delays for each channel
sp_gain – array with the gains for each channel
num_sp – number of the speakers.
filename – main file name. For each channel the number of the channel will be added at the end.

- **Example:**

sp_gain *and* ***sp_delay*** *are used from previous examples.*

- *input*

```
fs=44100;
SoundSpeed=340.25;
filename='C:\work\Vout';
[source_f, f] = wavread('C:\work\test.wav');
Voutputfiles(funky,f,sp_delay,sp_gain,16,filename);
```

- *Output*

```
The output files will be saved in 'C:\work\' with filenames:
test1.wav – for the first channel
test2.wav – for the second
…..
```

6. Function Vplot(speaker_coord,source_pos,show_sphere,num_sp)

This function visualizes speakers' positions. It can also plot a sphere with radius 1 unit (meter).

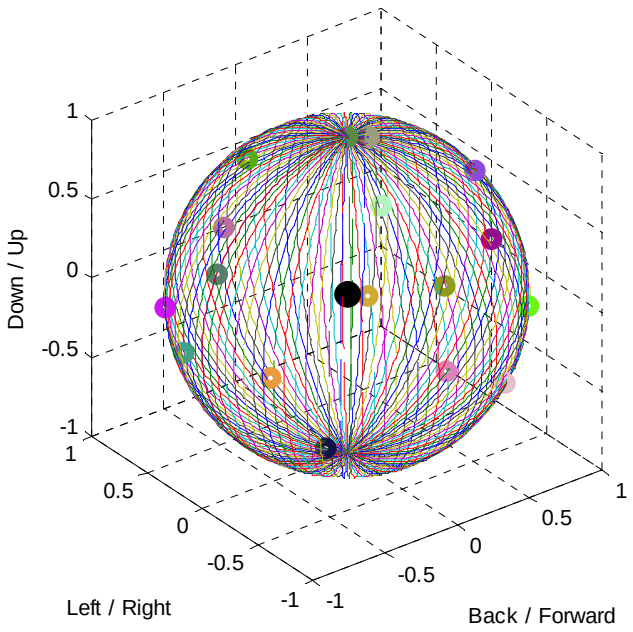
- *Input parameters:*

num_speakers – number of speakers. Here it can be any number, it is not restricted like in VBAP!
speaker_coord – The coordinates of each speaker in polar coordinate system. The format is following:
speaker_coord(i,1) = 1; % Distance must be in meters
speaker_coord(i,2) = 0; % Azimuth angle of the speaker
speaker_coord(i,3) = 90; % Elevation angle of the speaker
i is the speaker's number.
source_pos – the position of the sound source in polar coordinate system. The format is following:
source_pos(1,1) = 1; % Distance must be in meters
source_pos(1,2) = 45; % Azimuth angle of the source
source_pos(1,3) = 30; % Elevation angle of the source
show_sphere – if 1 plots a sphere with radius 1 unit (meter).

- **Example 1**
  - *input:*

speaker_coord *and* ***source_pos*** *are used from previous examples.*
show_sphere=1;
num_sp=16;

  - *output:*



- **Example 2**
  - *input:*

speaker_coord *and* ***source_pos*** *are used from previous examples.*

```
show_sphere=0;
num_sp=16;
```

  - *output:*