

## SOLVITMEDIA MEMO

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Subject: Relationship between balance and volume  
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### Mathematical description of the relationship between balance and physical volume in SoundIt<sup>®</sup>

Denotation of Volume,  $V = (V_L, V_R)$ , where  $V_L$  is the left volume and  $V_R$  is the right one.

For  $V$ , it holds the following:

1.  $V_L^2 + V_R^2 = R^2$ , where  $R$  is constant. That is, Volume  $V$  can be thought that it goes through real-imaginary coordinate with radius of  $R$ .
2. Denoting the angle between  $V_L$ -axis,  $(V_L, 0)$  and volume vector  $V, (V_L, V_R)$  as  $\theta$ ,  
 $V_L = X(\theta)$  and  $V_R = Y(\theta)$ , where  $X$  and  $Y$  are functions on angle  $\theta$ .
3. [Boundary condition]  $V_L$  and  $V_R$  exist between 0 and  $R$ , which means that  $\theta$  ranges from 0 to  $\pi/2$ .

Thinking from the conditions above, we can choose the angle  $\theta$  as balance variable so that we can calculate new Volume  $V'$  when given new  $\theta'$ :

$$V_L' = R \cos \theta' \text{ and } V_R' = R \sin \theta' \quad \text{----- (1)}$$

Reversly, we can also determine the angle  $\theta$  from given vector,  $V$ .

$$\theta = \tan^{-1}(V_R/V_L) \quad \text{----- (2)}$$

