

**[0013]** Thus, there is a need for a new method that overcomes the above noted deficiencies while at the same time, achieves full shot-by-shot directional designation on a shot-by-shot basis.

### **SUMMARY**

**[0014]** ~~As detailed herein~~According to an aspect of the present invention, a method for source directivity compensation of seismic data  $d$  with a given source directivity related to a subsurface is introduced~~provided~~. The method includes obtaining directional operators  $r$ ; calculating a model  $u$  with a modified source directivity based on (1) seismic data  $d$ , and (2) an operator that is a combination of the directional operators  $r$  and a reverse transform operator  $L$ ; using the model  $u$  to obtain seismic data  $d_{free}$  with modified source directivity; and generating a final image of the subsurface using seismic data  $d_{free}$ .

**[0015]** ~~According to another exemplary embodiment~~According to another aspect of the present invention, there is a computing device for source directivity compensation of seismic data  $d$  with a given source directivity, related to a subsurface. The computing device includes a processor configured to, obtain directional operators  $r$ ; calculate a model  $u$  with a modified source directivity based on (1) seismic data  $d$ , and (2) an operator that is a combination of the directional operators  $r$  and a reverse transform operator  $L$ ; use the model  $u$  to obtain seismic data  $d_{free}$  with modified source directivity; and generate a final image of the subsurface using seismic data  $d_{free}$ .

**[0016]** ~~According to still another exemplary embodiment~~According to another aspect of the present invention, there is a non-transitory computer readable medium storing computer executable instructions, wherein the instructions, when executed by a computer, implement ~~the above-noted~~ a method for source directivity compensation of seismic data

$d$  with a given source directivity, related to a subsurface, the method comprising:  
obtaining directional operators  $r$ ; calculating a model  $u$  with a modified source directivity  
based on (1) seismic data  $d$ , and (2) an operator that is a combination of the directional  
operators  $r$  and a reverse transform operator  $L$ ; using the model  $u$  to obtain seismic data  
 $d_{free}$  with modified source directivity; and generating a final image of the subsurface using  
seismic data  $d_{free}$ .