

(12) **United States Patent**  
**Alhukail et al.**

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(54) **SYSTEM, MACHINE, AND COMPUTER-READABLE STORAGE MEDIUM FOR FORMING AN ENHANCED SEISMIC TRACE USING A VIRTUAL SEISMIC ARRAY**

(58) **Field of Classification Search**  
CPC ..... G01V 1/28  
(Continued)

(71) Applicant: **Saudi Arabian Oil Company**, Dhahran (SA)

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(57) **ABSTRACT**

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Embodiments of a system are provided for forming enhanced seismic array traces using virtual seismic sensors in addition to the real seismic sensors to form a virtual seismic array. The system receives the signal responses from the real sensors, processes the signal responses from the sensors to define virtual signals using a narrowband decomposition of the complex envelope of the sensor signal responses, calculates second- and fourth-order statistics to derive steering vectors for the array of real sensors, and forms a virtual seismic array in response thereto. Machines, computer program product, and computer-implemented methods are provided for forming enhanced seismic array traces by receiving the array responses from sensors, processing the signals to define virtual sensor signals and a virtual seismic array, and forming an array response for the virtual seismic array to form a seismic trace of enhanced resolution.

(65) **Prior Publication Data**

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**Related U.S. Application Data**

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**G01V 1/28** (2006.01)  
**G01V 1/32** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **G01V 1/28** (2013.01); **G01V 1/32** (2013.01); **G01V 2210/55** (2013.01); **G01V 2210/57** (2013.01)

**21 Claims, 6 Drawing Sheets**

