Please fill in the name of the event you are preparing this manuscript for.	2020 International Petroleum Technology Conference
Please fill in your 5-digit IPTC manuscript number.	IPTC-19953
Please fill in your manuscript title.	Impact of Oil Reservoir Environment on Wireless FracBots Network

Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Abdallah A.	Alshehri	Saudi Aramco
Abdulelah H.	Shewoil	Saudi Aramco

Abstract

Objectives/Scope:
Fractures Robots (FracBots) are underground IoT self-contained wireless sensing nodes that can be used to be deployed underground in reservoirs to map hydraulic fractures (HF) and monitor key reservoir conditions in real time data, temperature and pressure. A lot of FracBots will be injected inside HFs to establish the network connectivity among FracBot-to-FracBot to generate, exchange data inside the reservoirs. FracBots technology is based on wireless underground sensors network (WUSN), a very promising technology suited the application in HFs network but developing such a system is extremely challenging due to many environmental obstacles. Main challenges are size, harsh environment, and energy limitations that affect an underground wireless link.

Methods, Procedures, Process:
FracBots system is mainly made up of a base station (BS), a gateway, and many FracBots. Main function of the BS transmits power to charge FracBots, collecting data from FracBots, and finally sending data to gateway that further process collected data. FracBots nodes will sense required data, communicate among them wirelessly and then transmit data to BS. The system is simulated via COMSOL Multiphysics with the BS made up of different aluminum antenna geometries and FracBot made up of a copper loop antenna.

Results, Observations, Conclusions:
We discuss some of the available wireless communication techniques and compare electromagnetic waves (EM) and magnetic induction (MI) wireless communication for reservoir HFs environment in terms of the path loss model, path loss parameters, and advantages and disadvantages of each technique. Moreover, we provide several COMSOL simulations that validate our comparison, the charging operation, effect of the BS geometry, and the importance of omnidirectional antenna in the FracBots system. Our COMSOL models also includes analysis for different power allocations, distances between the transmitter and the receiver, BS shapes, and FracBots orientation with respect to the BS. After comparing both EM and MI communication techniques in reservoir fractures environment, we found that in order to use a practical antenna size and achieve a practical communication range at the same time, MI communication must be deployed. Further, we also proves the critical importance of an omnidirectional antenna in FracBots and validates effect of an alignment angle on the path loss model of MI system. The alignment angle is angle between the axes of transmitter and receiver.

Novel/Additive Information:
COMSOL models modeled the BS as one armed, two armed, and X armed dipole antenna and found that the optimal BS geometry could be a directional array antenna based on magnetic field measurements obtained from different dipole antenna geometries.
Microseismic and tiltmeter surveys are ones of many technologies available to nowadays characterize HFs but they are expensive, approximate, and time consuming. FracBots technology provides mapping of HF and in-stiu information that aims at optimizing fracturing jobs.