

https://www.researchgate.net/publication/262025720_Effect_of_Rainwater_and_Seawater_on_the_Permittivity_of_Denim_Jean_Substrate_and_Performance_of_UWB_Eye-Shaped_Antenna

Scihub Link

I have found this paper which is discussing very good about wetting of jeans substrate,

Generally

We have

$$\text{Permittivity}(\epsilon) = \epsilon' - j\epsilon''$$

The paper analysis the jeans substrate from 2 – 12 GHz under wet and dry conditions.

The paper clearly stating that the two components ϵ' and ϵ'' will increase under wet condition.

In the paper, it is stated that

From 2 – 12 GHz the jeans ϵ' varies from 2.1 -2.3 under dry condition,

But it was increased and varies from 37 – 26 under wet condition.

Similarly

ϵ'' which is varying between 0.15 -0.45 from 2 – 12 GHz under dry condition,

Increased and varied as 7.2 – 19.3 under wet

Thus, the author is concluding the both will increase.

⇒ To test our antenna for the wet condition, I have picked ϵ' and ϵ'' values in between the varying values as our frequency is 2.45Ghz

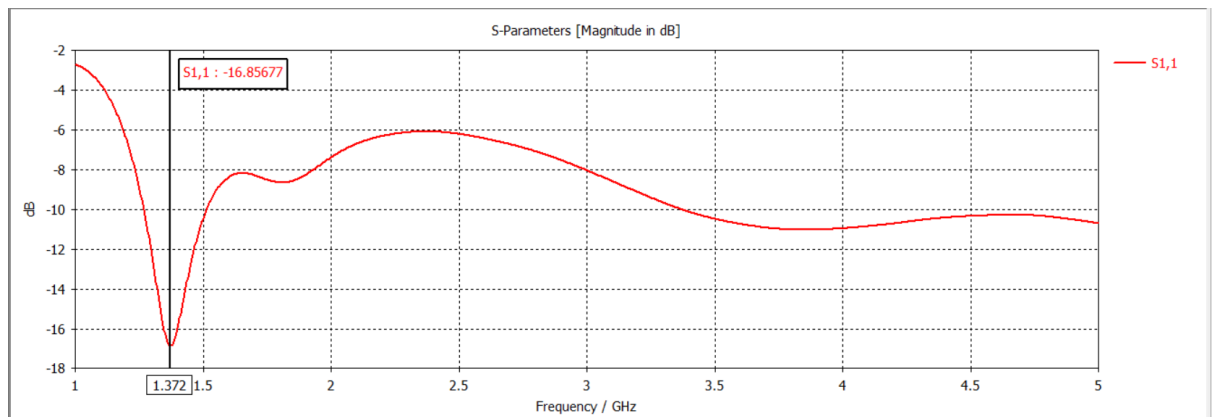
⇒ I have chosen $\epsilon' = 35$ and $\epsilon'' = 7.8$,

Now my Permittivity(ϵ) = $\epsilon' - j\epsilon'' = 35 - j7.8$ where its magnitude comes out as 35.8 and loss tangent($\tan\theta$) is 0.223

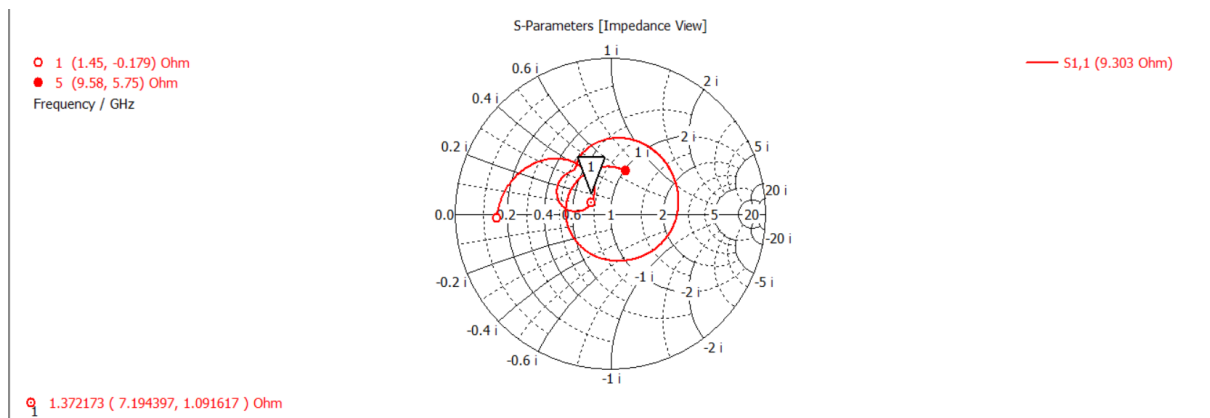
⇒ I have modified our initial permittivity which is 1.67 to 35.8 and initial loss tangent which is 0.0025 to 0.223.

⇒ With all the other parameters remained unchanged the simulation results came as below

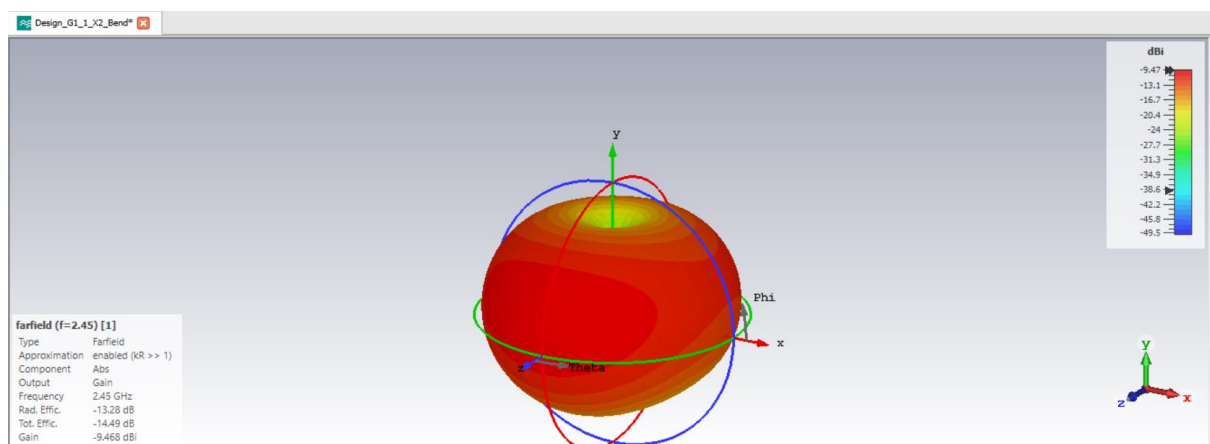
S11



Smith Chart



Gain



I have evaluated following cases also

- ⇒ If I increased permittivity keeping loss tangent constant, there is no change in the reflection coefficient and its frequency but the gain becomes more negative.
- ⇒ If I decreased permittivity keeping loss tangent constant, there is change in the reflection coefficient, and the gain of the antenna is negative with a value less than the above value
- ⇒ If I increased loss tangent keeping permittivity constant, there is no change in s_{11} and gain.
- ⇒ If I decreased loss tangent keeping permittivity constant, the reflection coefficient increased at the same resonance frequency and there is no change in gain
- ⇒ If I increase both, reflection coefficient decreased minimally and gain unchanged
- ⇒ If I decrease both, reflection coefficient unchanged, gain is negative but it is less compared to the first.