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# Modeling the interplay between interneuron and pyramidal cell during seizures

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## Summary

We present an ionic current model composed of Hodgkin-Huxley type neurons aided by variable ion concentration dynamics to investigate the role of various mechanisms in neuronal interplay seen during seizure-like events [1].

## Methods

We model both cells using a two compartmental model with (1) axo-somatic, and (2) dendritic compartments. The equilibrium potentials for various ion concentrations and leak conductance are updated based on instantaneous ion concentrations inside and outside the cell using Goldman-Hodgkin-Katz equation. The $K^+/Na^+$ concentration in the interstitial volume surrounding each cell was continuously updated based on $K^+/Na^+$currents across the neuronal membrane, $K^+/Na^+$ pumps, uptake by the glial network surrounding the neurons, and lateral diffusion of $K^+$ within the extracellular space.

## Results

We investigated the cellular mechanism shaping the interplay between interneurons and pyramidal cells using compartmental models of two cells coupled through synaptic inputs and extracellular $K^+$ diffusion. We find physiological conditions under which the two cells are locked into interplay during seizure-like events. The two cells exhibit the interplay when (1) the lateral $K^+$ diffusion is taken into account, (2) Inhibitory and excitatory synaptic strengths are within certain range, and (3) The persistent sodium current is included in the pyramidal cell.

## Conclusion

We conclude that the extracellular diffusion of $K^+$ ions and the persistent sodium current play a major role in shaping the interplay between IN and PC during seizure-like events.

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## References

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