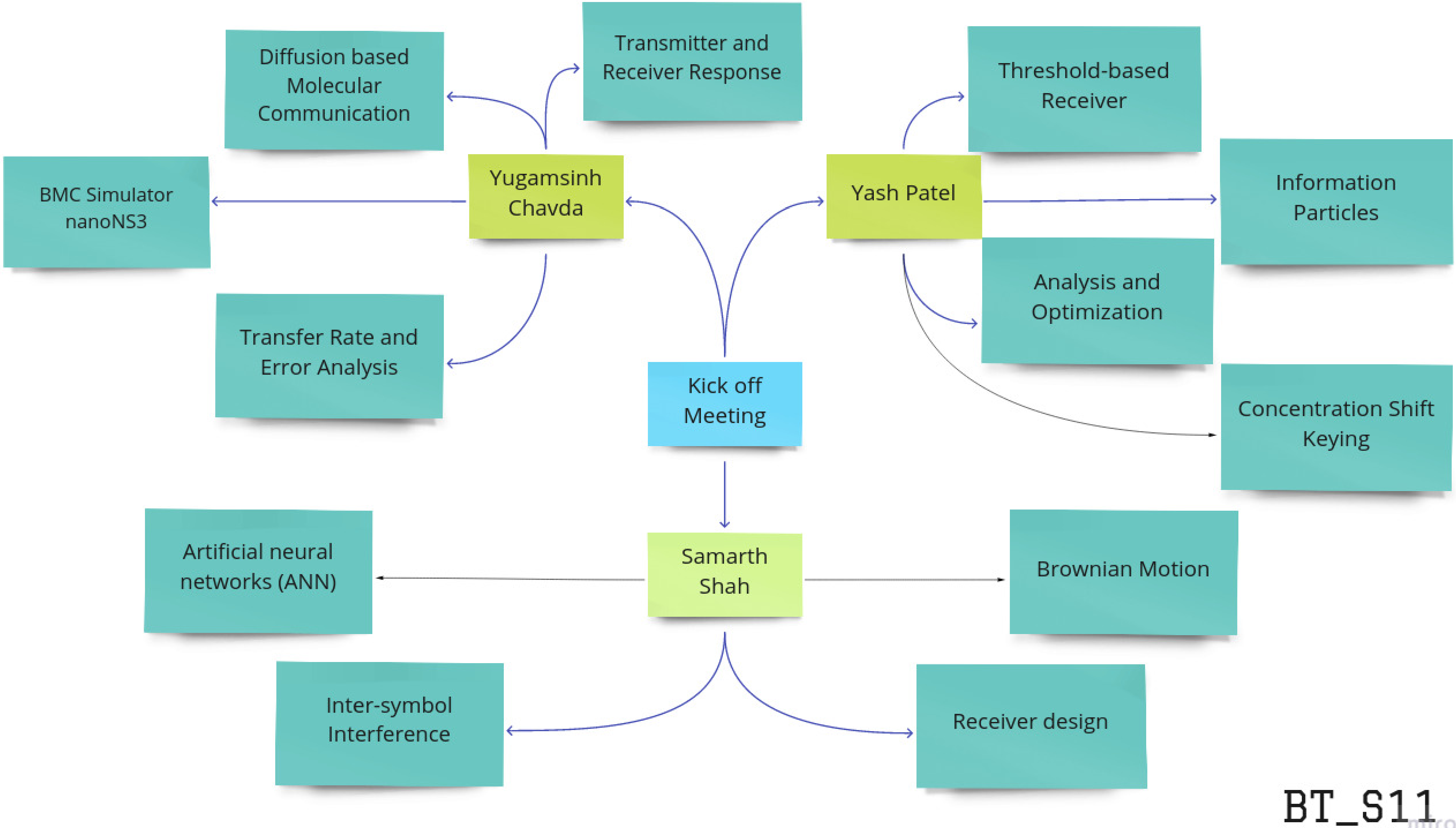

Diffusion based Molecular Communication
Transmitter and Receiver Response
Threshold-based Receiver
BMC Simulator nanoNS3
Yugamsinh Chavda
Yash Patel
Information Particles
Analysis and Optimization
Transfer Rate and Error Analysis
Kick off Meeting
Concentration Shift Keying
Artificial neural networks (ANN)
Samarth Shah
Brownian Motion
Inter-symbol Interference
Receiver design
BT_S11
miro

Our Selection Process

What we have learned

Data given in each article

Base Article

Three - Dimensional Channel Characteristics for Molecular Communications with an Absorbing Receiver

- Derivation of the first hitting probability function in a 3-D environment
- Analytical solutions to molecule absorption rate and fraction of absorbed molecules in a 3-D environment.
- Simulation results are verified with the analytical formulations.

Basically this article focuses on the analytical solutions for Molecular Communications With an Absorbing Receiver.

Molecular Communications: Model-Based and Data-Driven Receiver Design and Optimization

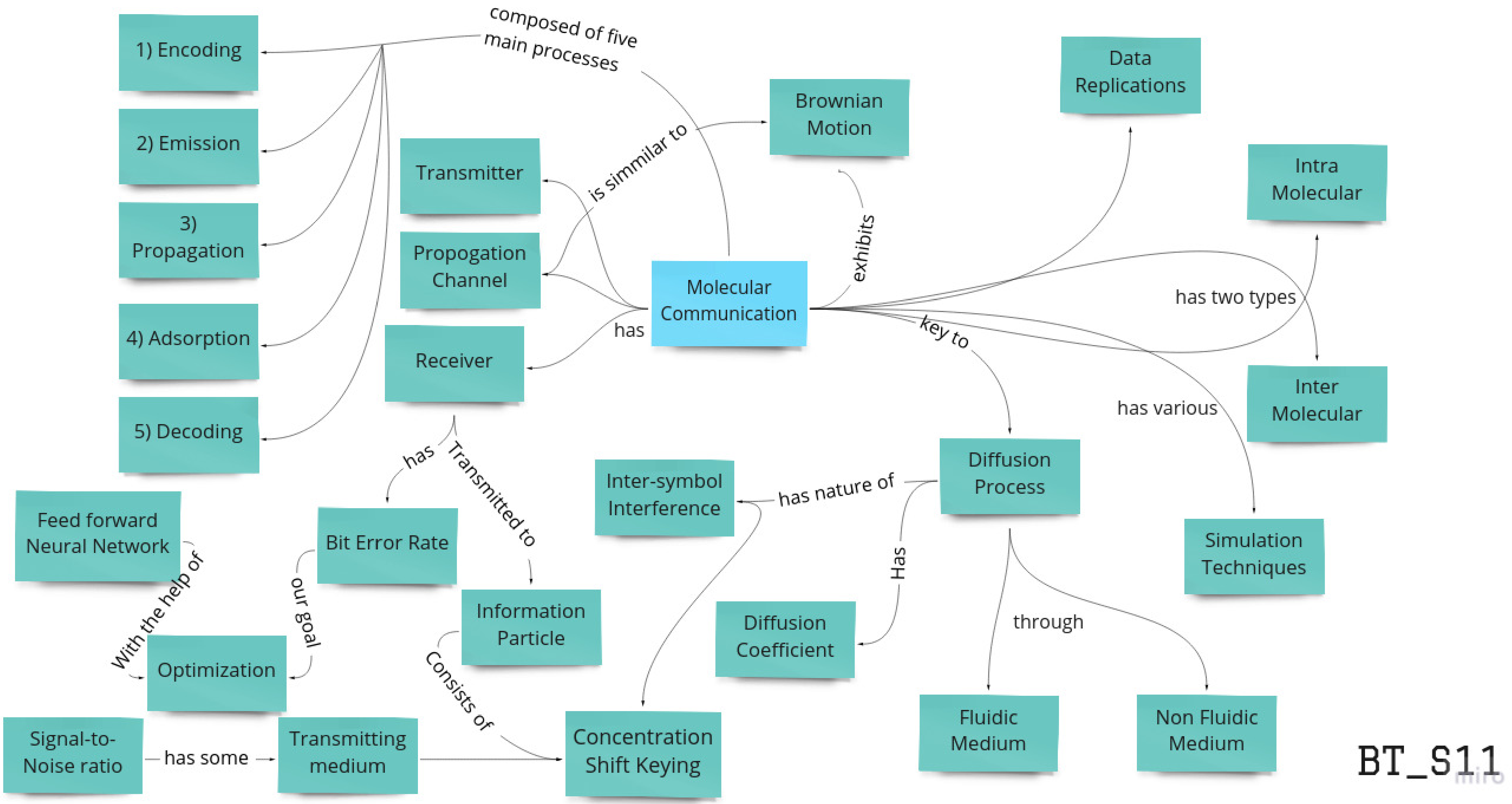
- Going to Analyze and Optimize the BER (Bit Error Rate) after transmission takes place through diffusion process
- Because of intrinsic property of diffusion process ISI (Inter-Symbol Interference) will be problamatic for reliable communication
- Based on this, different threshold based receiver whose main difference consists of the amount of prior information

As the article is based on BER we are given the hitting rate of information particle as well as the probability of receiving particles and also the different thresholds to decide the binary result.

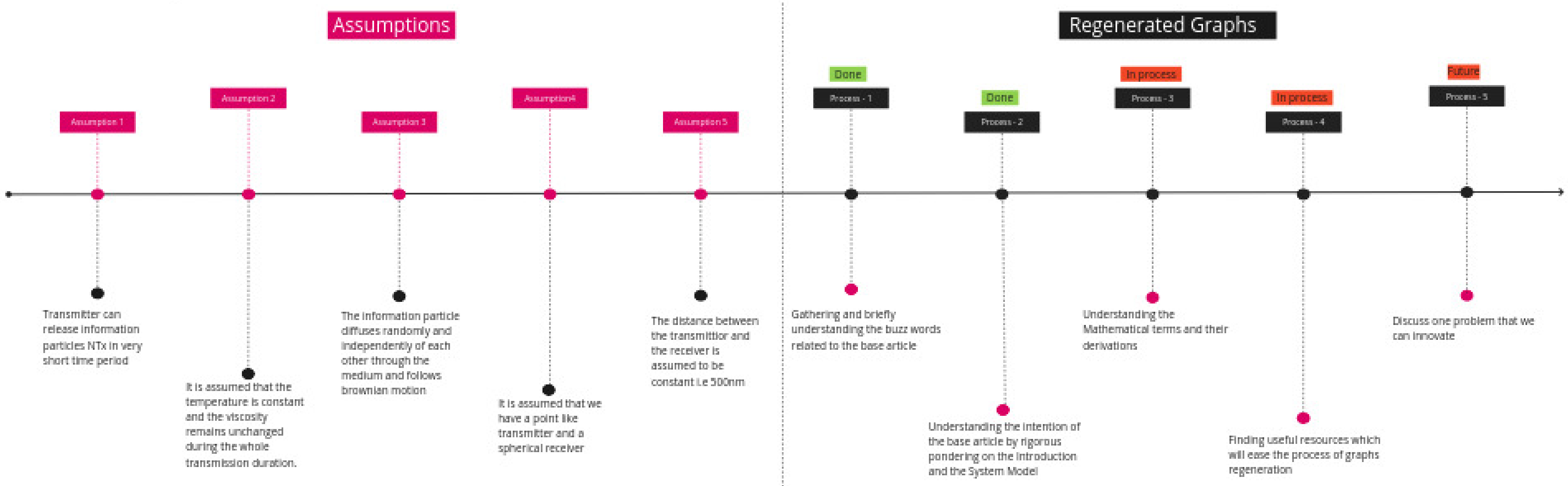
Understanding Communication via Diffusion: Simulation Design and Intricacies

- Understanding Brownian motion for Analyzing the Performance ofa given Communication via Diffusion system
- Understanding the various parameter necessary for communication in a 3-D environment
- Understanding the various Data Replication techniques necessary during implementation

As Compared to the other two articles, here we get a better understanding about the process which occur in CvD situation with pictorial representation of the produced result and understanding the various techniques executed to achieve the desired results.


composed of five main processes
1) Encoding
2) Emission
3) Propagation
4) Adsorption
5) Decoding
Transmitter
Propogation Channel
Receiver
is simmilar to
Brownian Motion
Data Replications
Intra Molecular
Inter Molecular
exhibits
Molecular Communication
has
has two types
key to
has various
Diffusion Process
Simulation Techniques
has nature of
Inter-symbol Interference
Has
Diffusion Coefficient
through
Fluidic Medium
Non Fluidic Medium
has
Transmitted to
Bit Error Rate
Information Particle
our goal
Consists of
Feed forward Neural Network
With the help of
Optimization
Signal-to-Noise ratio
has some
Transmitting medium
Concentration Shift Keying
BT_S11
miro

Topics to be discussed



Description of Article

1. Purpose
To trace receiver/molecules received of molecular communication and try to optimize the BER at the receiver end.

2. Transmission through channel
We consider Diffusion based transmission(Fick's second law of diffusion) and it will follow the brownian motion.

3. Random distribution's functions
1. Poisson RV: At receiver's end particles follow Poisson random distribution.
2. Gaussian RV: Approximations distributions of received bits
3. Gamma RV: BER as a function of threshold(tau) shows gamma distribution

4. Factors affecting the reliability of communication
There are mainly two noises that distracts the communication.
1. Diffusion molecular noise(Background noise)
2. ISI(Inter Symbol Interference) because of receiving molecules from the previous time slots and that is why we are using different threshold based receivers that threshold will put the time constraint that before this time molecules should be received if not then it will 0 bit transmitted

5. List of simulation parameters and their description

Parameters	Description
ΔT	Discrete Time length
T	Slot length
L	Channel length
d	Distance between transmitter and center of the receiver
r	Receiver Radius
λ_0	Background noise power per unit time

6. Optimal Bit Memory Receiver VS Data driven Bit Memory Receiver

Optimal Zero Bit Memory Receiver
->Let C = Rs denotes the average received particles at the j time slot if N Particles were released
->As the number of particles arriving in a particular time interval are random, we use Poisson random variable
->The rationale behind this approach is that the values of Ci for 1 < i < L are unknown, but the averaged ISI, equal to sum{1,L}(Ci/2), is known where L is the channel Length and it is assumed to be 3.
->Under these Assumptions we find the probability of the received particles

Optimal One Bit Memory Receiver
->The One bit memory receiver has more prior information as compared to the Zero bit memory receiver.
->In simple terms, in contrast to the zero-bit memory receiver
that accounts only for the number of received particles in the time-slot of interest, the one-bit memory detector adapts the
detection threshold as a function of the previously transmitted
bit.

Optimal K Bit Memory Receiver
->We generalize the design of the K bit Memory Receiver by getting an inspiration from the One bit receiver. The size of the K bit receiver may also be equal to the length/size of the Channel(L).
->This setup yields the optimal performance but needs more a priori information on the previously detected bits, which increases
the complexity of the receiver.

Data Driven Zero Bit Memory Receiver
->The main difference from the optimal bit memory receivers, here we don't need to have any prior information about the received particles.
->An ANN-based zero-bit memory demodulator is a system whose input consists of the received information
particles Ri at the Ith time-slot, and the outputs are the probabilities
that the transmitted bit is 0 or 1

Data Driven One Bit Memory Receiver
->If the one-bit memory receiver is considered, the input of the ANN is not just the number of received particles at the Ith time-slot, Ri, but also the estimated symbol at the (i-1)th time-slot, si-1.
->The same system setup as for the zero-bit memory receiver is considered with the only exception that the number of hidden layers is equal to 3 and the number of neurons per layer is 4.

Data Driven K Bit Memory Receiver
->The K bit receivers works same as that is the One bit Memory Receiver