# Research Plan for New Generation Iterative Prisoner's Dilemma

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19 April 2021

**Title:** 1.figure out a title for the paper

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## Background of the research

When is cooperation the better choice? And when should we choose to rather defect? In 1950, Albert Tucker named a particular two-player exchange game "The Prisoner's dilemma" [1]. This game captures the inherent difficulty of the choice between cooperation and defection in a single yes/no question. More complexity arises when the game is extended to its iterated version: allowing agents to interact multiple times. If the number of games to be played if unknown to the agents, they are forced to cooperate to achieve the maximal payoff.

This led to an interesting academic model which could be used to investigate behaviours of many systems. To better match nature, the iterated version was further extended by Smaldino et al. [2] by creating a 2D environment for agents to move around. The are slowly expending energy and have to maximize their payoff to survive; best performing agents are allowed to reproduce. Eventually, an equilibrium is achieved.

Many different aspects of this Spatial Iterated Prisoner's Dilemma (SIPD), were studied before. 2.add more examples (+ cite) of past research here - noise, R-D, pattern formation, ...

3.mention the counterintuitive results of the continuous game - double check this

However there are still many aspects of this game, which could be visited or given more scrutiny. By allowing the agents of a SIPD to communicate we can open up many more opportunities for more complex behaviour to emerge. This could also be a good environment for evaluating various gossip or consensus protocols. 4.introduce this better + cite (scuttlebutt, raft, paxos?, ...) maybe? And by stressing the environment with noise, harsh conditions, malicious agents, or limiting the transfer rate, we can throughly evaluate the behaviour of these algorithms in extreme conditions.

## Research Question

What can we learn from Spatial Prisoner's Dilemma, by allowing agents to communicate?

Interesting aspects if SPD with communication:

1. Limiting the rate and representation of information

2. Combinations of strategies for behaviour and communication
3. Using gossip (or consensus) protocols for dissemination of information
4. Add a secondary game for trading information **5.is this basically donation game?**

**6.Pick a concrete focus - discuss with responsible**

# Method

Implement the SPD: netlogo / custom implementation? Check the speed of netlogo. Can simulate milions of steps? Is it possible to expose the netlogo model over network? (Would be nice to allow interactive presentation of the research - distill-style)

Identify the aspects which would be interesting to measure.

1. convergence to cooperation (rate/time)
2. for the algorithms: the most extreme conditions tolerable
3. for trading information: price/value
4. ...

# Planning of the research project

## Week 0

1. Read preliminary research provided by the responsible professor
2. Read last year's student papers
3. Find more relevant papers
4. Think about interesting relevant research

## Week 1

1. Kick-off meeting
2. Setup LaTeX+ netlogo/other **7.check if netlogo would work** environment
3. Decide on a research question + narrow down the scope/focus of the paper.
4. Try to find some "PD with communication" papers
5. Find more relevant research: investigate the state of the art
6. Finish this planning

# References

[1] Kuhn, S. (2019). Prisoner's Dilemma. In Zalta, E. N., editor, *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University, winter 2019 edition.

[2] Smaldino, P. E., Schank, J. C., and McElreath, R. (2013). Increased costs of cooperation help cooperators in the long run. *The American Naturalist*, 181(4):451–463. PMID: 23535611.

# ToDo


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|---|---|
| 1. figure out a title for the paper | 1 |
| 2. add more examples (+ cite) of past research here - noise, R-D, pattern formation, ... | 1 |
| 3. mention the counterintuitive results of the continuous game - double check this | 1 |
| 4. introduce this better + cite (scuttlebutt, raft, paxos?, ...) maybe? | 1 |
| 5. is this basically donation game? | 2 |
| 6. Pick a concrete focus - discuss with responsible | 2 |
| 7. check if netlogo would work | 2 |