

**Cover Letter for the Submission of PhD Thesis Titled
"Sequential Controlled Sensing to Detect an Anomalous Process"**

Name of the Candidate: P. N. Karthik
Thesis Supervisor: Dr. Rajesh Sundaresan
Department: Electrical Communication Engineering, Indian Institute of Science, Bengaluru

Subject: Cover letter for the submission of PhD thesis titled "Sequential Controlled Sensing to Detect an Anomalous Process"

Dear Sir / Madam,

Attached is a copy of my PhD thesis titled "Sequential Controlled Sensing to Detect an Anomalous Process". The central problem addressed in the thesis is one of finding an anomalous process as quickly as possible subject to an upper bound on the error probability. This problem falls within the class of optimal stopping problems in decision theory. Prior works analysed the problem of finding an anomalous independent and identically distributed (IID) process quickly and accurately. In this thesis, we provide the first known extension to the case of Markov processes wherein the anomaly is that the transition probability matrix (TPM) of one of the Markov processes is different from the common TPM of each of the remaining processes. Our results are in the asymptotic regime of vanishing error probability.

We operate in the setting where out of K given Markov processes, only one Markov process can be observed at any given time in a sequential manner. The unobserved processes may either remain frozen until the next observation instant ("rested") or continue to evolve ("restless"). Further, the TPMs of the processes may or may not be known in advance. We study the following 3 cases: (a) rested processes with unknown TPMs, (b) restless processes with known TPMs, and (c) restless processes with unknown TPMs. For each of these cases, we explicitly characterize the asymptotic growth rate of the time taken to find the anomalous process as a function of the error probability. In the thesis, we bring out the key challenges to be overcome in the analysis and highlight our contributions.

The thesis is organized into five chapters. In the first chapter, we describe our motivation to study the setting of Markov observations and state the main objective. The second, third and fourth chapters of the thesis are devoted to a detailed study of the three cases described in the previous paragraph. In the fifth chapter, we provide some concluding remarks and discuss possible future directions to explore.

It gives me immense pleasure to share with you that the shorter versions of the second, third and fourth chapters were accepted for presentation at 3 consecutive editions of the IEEE International Symposium on Information Theory (ISIT). The contents of the second and the third chapters were also published in the IEEE Transactions on Information Theory.

I am happy to now make my thesis available for review by experts in the community. In conformance with the existing guidelines for thesis review, I will be grateful to you if the list of potential examiners for my thesis, as shared with you by my advisor Dr. Rajesh Sundaresan, can be contacted at the earliest possible. I will be happy to provide any information required from my end in addition to the documents uploaded through the ScholarOne portal. You may kindly contact me at the below mentioned email ids for any correspondence.

Yours Sincerely,

P. N. Karthik: periyapatna@iisc.ac.in
pnkarthik1992@gmail.com