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| **Invention Disclosure** |
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| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  | | --- | --- | --- | --- | | Record ID |  | Last Modified |  | | Invention Reference |  | Invention Short Title: Software defined Network Inference with Passive/active Evolutionary-optimal pRobing(SNIPER) |  | | View | Review Status and Patent Application Details | Invention Status | Invention Draft | |  | | | |  |  | | --- | --- | | Step 1 – Disclosure |  | |  | |      |  |  | | --- | --- | | Invention Disclosure Consideration |  | | **Your submission should include the answers to as many of these questions as possible:**  1.     Is the invention well aligned with a specific HP business strategy (i.e., block competitors by offensively asserting our patents against them, or build a “mine field” around our products to defensively protect HP’s freedom of action)?  2.     Is the invention likely to be a key component to a competitor’s business strategy?  3.     Is the invention likely to be part of a standard?  4.     Is the invention likely to be part of an IP Licensing program?  5.     Is the invention a futuristic technology bet that, while not in any current product plans, is likely to be an important technology for HP in the future?  6.     Will the invention still be technically relevant in 5-10 years?  7.     Is the invention difficult for a competitor to work around by using a different solution?  8.     Is the invention easily detectible if it were to be used by a competitor?  9.     Does the invention provide a surprising or unexpected result over what is already known?  10.   Is this invention technically complete enough to be filed within the next few months? | | | IMPORTANT WARNING!! PLEASE READ : |  |      |  |  | | --- | --- | | TO PREVENT ANY LOSS OF YOUR WORK DUE TO IPFUSION PERFORMANCE ISSUES PLEASE SAVE YOUR WORK EVERY TWO (2) MINUTES | | | CLASSIFICATION AND INDEXING |  |      |  | | --- | | FILLING IN THE FORM**There are five sections on this page and listed in the menu on the left side of the screen you will find the screens for entering Inventors, Related Art (optional) and Attachments. You can click on the link to go to that section.**  SAVING YOUR INFORMATION**You can fill the sections in any order. After completing each section, click on the "Save" button before leaving each step to retain the information you have entered. Even if there are invalid answers, the record will be saved and you can return to finish entry.**  EDITING YOUR DRAFT**If you decide not to complete all sections in a single session, you can simply leave the site or close the browser. You can subsequently login again and continue from where you left off.**  SUBMITTING YOUR COMPLETED DRAFT**After you fill in and review all the sections, click on Step 4 - 'Inventorship' on the left. Once all inventors are added, press the ‘Submit’ button. Inventors no longer need to approve. Once ‘Submit’ has been selected, your disclosure is submitted and no edits or modifications accepted.** | | **1. (Required) Country of Origin** | | United States of America |      |  | | --- | | **2. (Required) US Export Control** | | 2.13 – None | | **3. (Required) Disclosure Classification** | | 5.7.8 - HPL-Networking-and-Mobility (HPL-Network-Mobility) |      |  |  | | --- | --- | | **4. Project and Product Name(s)** | | | Programmable Measurement Framework for Uncovering Global Events in Dynamic Network Environment (IRP Grant UC Davis) | | | TITLE AND ABSTRACT |  |      |  | | --- | | **5. (Required) Invention Title** | | **Software defined Network Inference with Passive/active Evolutionary-optimal pRobing**  **(SNIPER)** | | **6. (Required) Short Title** | | **Evolutionary Optimal Passive/Active Probing for Software defined Network Measurement and Inference** |      |  |  | | --- | --- | | **7. (Required) Abstract**  **A key requirement for network management is accurate and reliable network monitoring where critical information about internal characteristics or states of the network(s) must be obtained. In today's large-scale networks, this is a challenging task due to the hard constraints of network measurement resources. In this paper, a new framework (called SNIPER) is proposed where we use the flexibility provided by Software-Defined Networking (SDN) to design the optimal observation or measurement matrix which leads to the best achievable estimation accuracy using Matrix Completion (MC) techniques. Here, to cope with the inherent complexity of the process of designing large-scale optimal observation matrices, we use the well known Evolutionary Optimization Algorithms (EOA) which directly target the ultimate estimation accuracy as the optimization objective function. We evaluate the performance of SNIPER using both synthetic and real network measurement traces from different network topologies and by considering two main applications including network traffic and delay estimations. Our results show that this framework is generic and efficient that can be used for a variety of network performance measurements under hard constraints of network measurement resources. Also, to demonstrate the effectiveness and feasibility of our framework, we have implemented a prototype of SNIPER in Mininet environment.** | | |  | | | DESCRIPTION OF INVENTION |  |      |  | | --- | | **8. (Required) Problems Solved** | | **Under hard constraints of network measurement resources, designing an evolutionary optimal observation matrix which leads to the best estimation accuracy via applying matrix completion techniques is addressed. Here, we show to appropriately model a solution and apply evolutionary optimization techniques to design such an optimal observation matrix. We also address different practical issues such as scalability and deployabilty for the implementation of the SNIPER framework.**  **The effectiveness of this method has been evaluated using both synthetic and real network measurement traces from different network topologies in two main applications including network traffic and delay estimation, and further, by implementing a prototype of SNIPER in Mininet environment.** | | **Diagrams - Create appropriate diagrams (schematics, drawings, sketches, flowcharts, etc.) to illustrate your proposed solution.  Attach these using the "Attachments" menu option on the top left hand side of the screen. (Do not attach any if Export Controlled)** |      |  | | --- | | **9. (Required) Prior Solutions** | | **In computer networks, network management refers to the activities, methods, procedures, and tools that pertain to the operation, administration, maintenance, provisioning and security of networked systems. To meet the QoS agreements, a key requirement for network management is accurate and reliable network monitoring where critical information about internal characteristics or states of the network(s) must be directly measured or indirectly inferred. In today's complex networks, the direct measurement of network's Internal Attributes of Interest (IAI) can be challenging or even inefficient and infeasible due to the hard constraints of network measurement resources including the limited number of Ternary Content Addressable Memory (TCAM) entries at switches, the limited processing power and storage capacity and limited available bandwidth in active network performance measurement. Network Inference (NI) techniques are powerful network monitoring tools that can help estimate the IAI based on a limited set of measurements. Therefore, NI problems are naturally ill-posed in the sense that the number of measurements are not sufficient to uniquely and accurately determine the solution. Hence, side information from different perspectives and sources must be incorporated into the problem formulation to improve the estimation precision.** | | **10. (Required) Description** | | **The key idea behind our network inference invention is to jointly use the flexibility provided by Software Defined Networking along with modern Matrix Completion NI techniques for active/passive network performance measurement. In this invention, we use evolutionary optimization algorithms to intelligently sample a sub-set of IAI which leads to the maximum accuracy via using matrix completion NI techniques. Here, to target the ultimate estimation accuracy and to reduce the complexity of integer optimization techniques, we use evolutionary algorithms to design our optimal binary observation matrix.** |      |  |  | | --- | --- | | **11. (Required) Advantages** | | | **The SNIPER framework advantageous can be summarized as the following**   1. **Under hard constraint of network measurement resources this method can design the optimal binary observation matrix which provides a better estimation accuracy while it uses a small portion of the measurement resources** 2. **It is an efficient framework that can be used for different SDN based network measurement and inference such as per-flow size, delay, throughput and loss estimation** 3. **It is compatible with recent trends in developing more smart and agile SDN platforms where data plane APIs and switches are able to execute codes inside the device with no further interaction with the controller** 4. **Since IAI are directly measured without interaction with other IAI, thus, the SNIPER framework is easily depolayable and does not suffer from any aggregation feasibility issues** | | | DATES / INVENTION HISTORY |  |      |  | | --- | | **12. (Required) Published Externally** | | Yes | | **13. Date Published Externally** | | 23 July 2014 |      |  | | --- | | **14. External Publication Details** | | The attached paper will be submitted to the IEEE Infocom2015 on 23 July 2014. | | **15. (Required) Offered for Sale, Announced, Purchased or Sold** | | No |      |  | | --- | | **16. Date of Offered for Sale, Announced, Purchased or Sold** | |  | | **17. Offered for Sale, Announced, Purchased or Sold Details** | |  |      |  | | --- | | **18. (Required) Disclosed** | | Yes | | **19. Disclosure under CDA** | | Yes |      |  | | --- | | **20. Date Disclosed** | | 15 Nov 2013 | | **21. Disclosed Details** | | This is joint work between HP Labs and UC Davis under IRP Grant. |      |  | | --- | | **22. (Required) Next Six Months** | | Yes | | **23. Described** | | Yes |      |  | | --- | | **24. Described Details** | | Slides and Paper | | **25. (Required) Build, Modeled, Used, or Tested** | | Yes |      |  | | --- | | **26. Date Built, Modeled, Used or Tested** | | 15 Feb 2013 | | **27. Contract** | | Yes |      |  | | --- | | **28. Government Contract Number** | |  | | **29. Contract Details** | | Programmable Measurement Framework for Uncovering Global Events in Dynamic Network Environment (IRP Grant UC Davis) |      |  | | --- | | **30. Related Disclosure** | | Yes | | **31. Related To** | | 700208663 |      |  | | --- | | **32. Related Disclosure Explanation** | |  | | **33. (Required) Standards** | | No |      |  |  | | --- | --- | | **34. Identification of Standard** | | |  | | | ADDITIONAL INFORMATION |  |      |  | | --- | | **35. Potential Licensing Opportunities** | |  | | **36. Potential Licensing Contacts** | |  | | **STEP 2 - ATTACHMENTS** | | |  |  |  | | --- | --- | --- | | Document/Title | Date | Document Type | |  |  |  | |  |  |  | |      |  | | --- | | **STEP 4 - INVENTORSHIP** | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Email | Name | Role | Phone | % | Approval Date | Approved By | Signature | | [mmalboubi@ucdavis.edu](mailto:mmalboubi@ucdavis.edu) | Mehdi Malboubi | Inventor |  |  |  |  |  | | gyl0511@gmail.com | Yanlei Gong | Inventor |  |  |  |  |  | | wangxiong@uestc.edu.cn | Wang Xiong | Inventor |  |  |  |  |  | | [chuah@ucdavis.edu](mailto:chuah@ucdavis.edu) | Chen-Nee Chuah | Inventor |  |  |  |  |  | | [puneet.sharma@hp.com](mailto:puneet.sharma@hp.com) | Puneet Sharma | Inventor | [+1 650 236 5436](tel:%2B1%20650%20236%205436) |  |  |  |  | | | |