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SEESL Technical Report

NTCP SCRAMNet Control Plugin Validation

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1. Introduction

The NTCP SCRAMNet Control Plugin is an interface to our control systems to allow communications with the NEESgrid Teleoperations Control Protocol. This allows us to participate in multi-site, distributed hybrid tests. Our control systems, for both our actuators and shake tables, communicate on a shared-memory network called SCRAMNet. This plug-in translates control commands received over the Internet, via NTCP, to control commands on the SCRAMNet, and vice-versa.

The main target of this plug-in, is to allow multi-site, distributed pseudo-dynamic testing, but it is capable of controlling all of our static and dynamic actuators, and additionally both of our shake tables. The main limitation is the speed and reliability of transporting control commands over the internet.

2. Software Availability

This software is freely available and released under an MIT style license which is open source compatible. A download package is available at:

<http://nees.buffalo.edu/software/NTCPScramnetControlPlugin/>

3. Validation Protocol

There are three phases in the validation of this control plug-in. All tests will use the 5 site pseudo-dynamic used in the Fast MOST experiment as input. The validation protocol is shown below:

1. Local only, simulated control system
All remote sites are simulated locally, and the feedback from our control system, through SCRAMNet, is simulated. The purpose of this test is to ensure communication from the NTCP client, to our control plug-in, through the NTCP server.
2. Local only, real control system
The remote sites are simulated locally, but our site conducts the actual experiment with our control system in the loop using an actual specimen and actuators.
3. Distributed, real control system
All remote sites participate in the experiment with either computational simulations or real specimens.

In all validation tests we will be looking to see if the command signals received and the feedback sent by the plug-in is correct. We will also look to ensure the plug-in performs transactions with adequate speed and robustness.

4. Validation Results

All validation tests were conducted on June 29, 2004 as part of the Fast MOST project.

4.1. *Local only, simulated control system*

This test was carried out using a simple simulation of our actuator and control systems to provide feedback to the Simulation Coordinator. Below is the displacements received by the plug-in from the Simulation Coordinator.

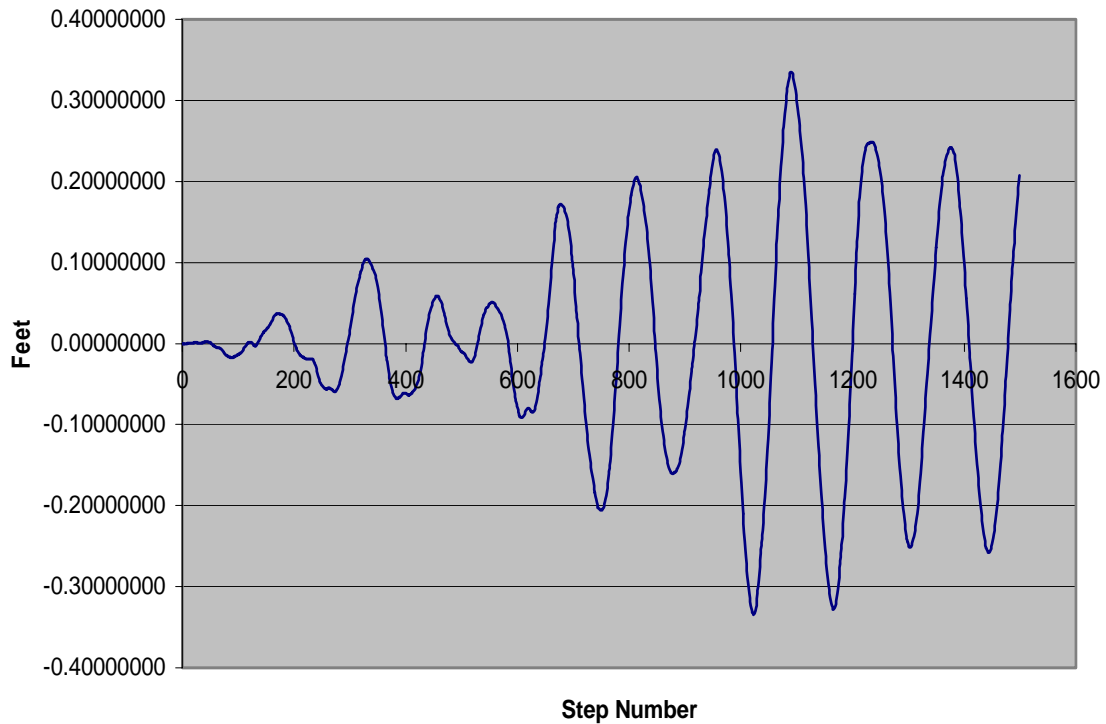


Figure 1: Displacement command received by plug-in

This displacements mach up exactly with the displacements from the Simulation Coordinator.

4.2. *Local only, real control system*

This test put a real specimen in the loop and provided actual feedback to the Simulation Coordinator.

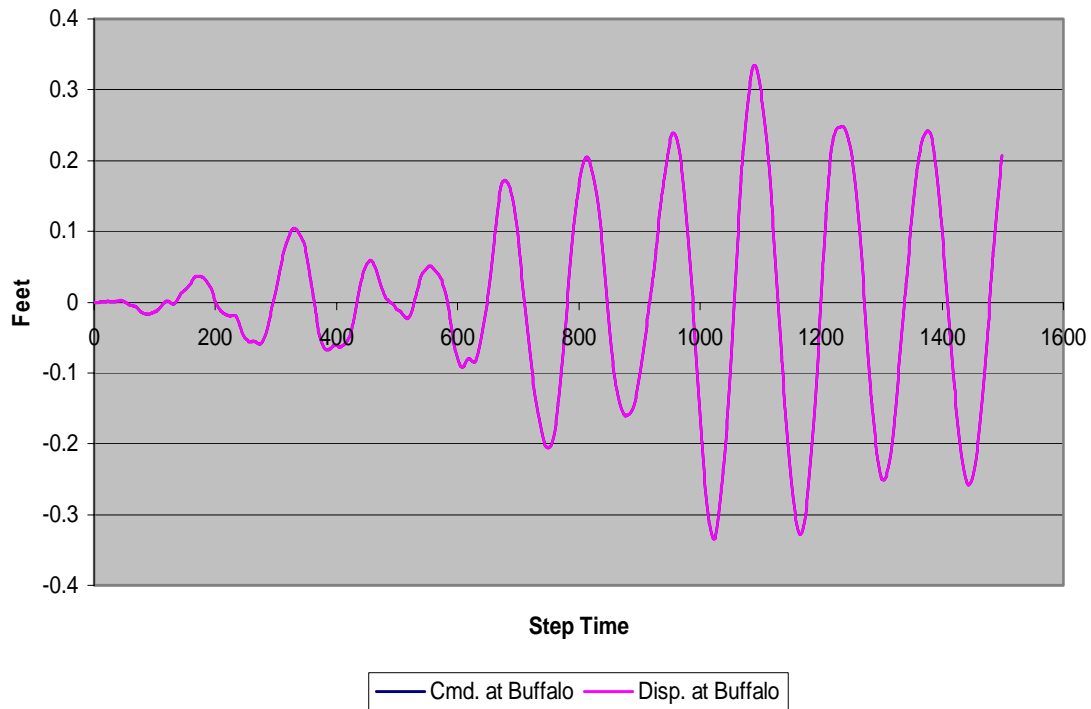


Figure 2: Commanded displacement vs. actual displacement

As you can see, the command and actual displacements match up almost exactly. This is because of the relatively small movements and the slow nature of the test.

4.3. Distributed, real control system

This is a full test of the system, including remote participants running physical and numerical simulations.

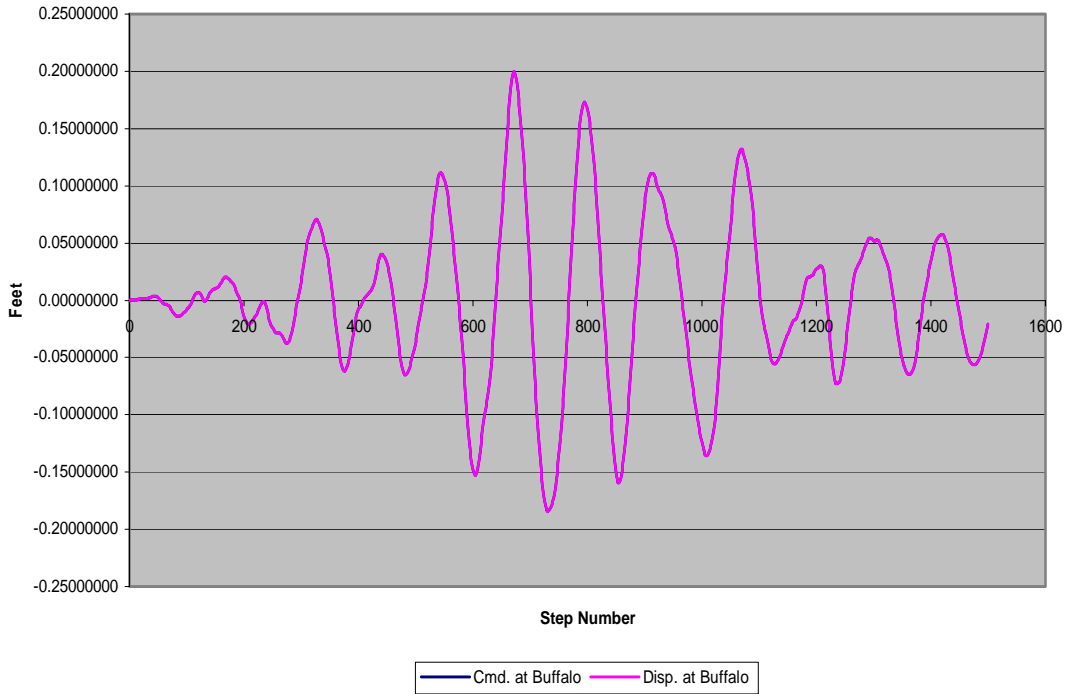


Figure 3: Commanded displacement vs. actual displacement

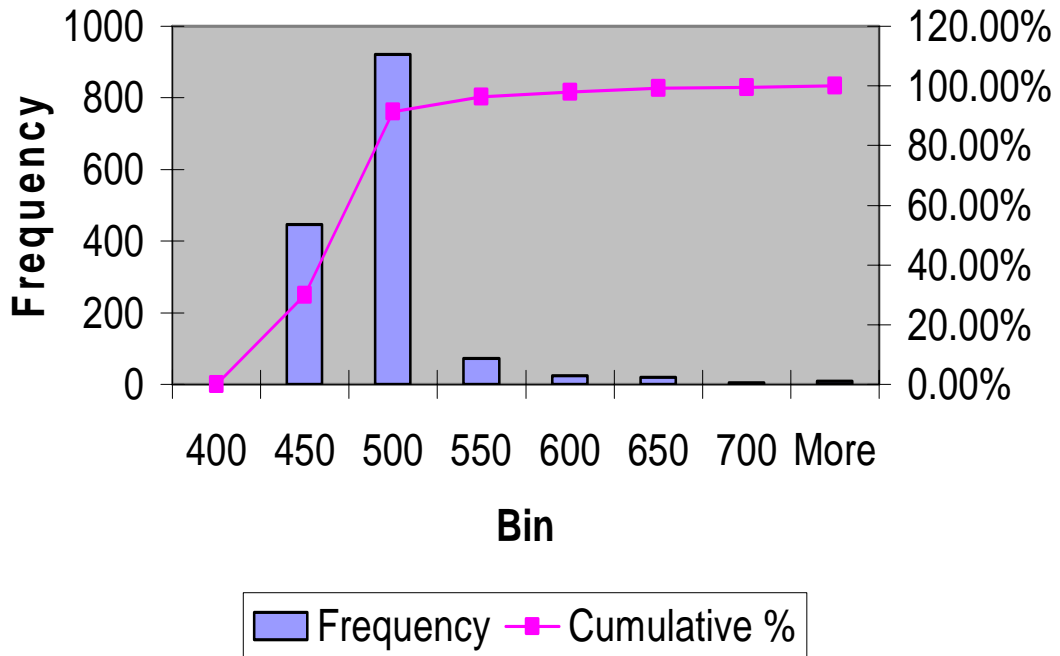


Figure 4: Histogram of step times (in ms)

It is seen that again the command and actual displacements agreed. The feedback agreed with the numerical simulations.

5. Conclusions

During the validation tests no issues were encountered with the plug-in. All results are consistent with what we expected and we consider this plug-in fully operational and validated.

This plug-in was used in subsequent tests in the Fast MOST project and the plug-in continued to perform up to specification.