



Outlook

Re: Permission to use images from MTS website in PhD thesis - Virginia Tech

From Balasubramanya, Bharath <bharathb@vt.edu>
Date Thu 11/21/2024 1:39 PM
To Gunderson, Jesse <jesse.gunderson@mts.com>
Cc Urbaniak, Ronald <ron.urbaniak@mts.com>; Lehman, Paul <Paul.Lehman@mts.com>

Great, thank you so much! Really appreciate the support.

Thank you
Bharath Balasubramanya
PhD Candidate
Virginia Tech | Mechanical Engineering

540 449-7506 | bharathb@vt.edu

From: Gunderson, Jesse <jesse.gunderson@mts.com>
Sent: Thursday, November 21, 2024 11:36:47 AM
To: Balasubramanya, Bharath <bharathb@vt.edu>
Cc: Urbaniak, Ronald <ron.urbaniak@mts.com>; Lehman, Paul <Paul.Lehman@mts.com>
Subject: RE: Permission to use images from MTS website in PhD thesis - Virginia Tech

Hi, Bharath.

As long as you acknowledge MTS as the source of your images, then it is okay for you to use them.

Thank you for asking and good luck!

Regards,

Jesse

Jesse C. Gunderson, P.E.
Sr. Product Manager
MTS Systems | ITW Corporation
Office: 952-937-4763
Cell: 612-462-0316
jesse.gunderson@mts.com

From: Balasubramanya, Bharath <bharathb@vt.edu>
Sent: Monday, November 18, 2024 6:18 PM
To: Gunderson, Jesse <jesse.gunderson@mts.com>
Subject: Re: Permission to use images from MTS website in PhD thesis - Virginia Tech

You don't often get email from bharathb@vt.edu. [Learn why this is important](#)

CAUTION: External Email

Thank you so much. I look forward to hearing from you.

Thank you
Bharath Balasubramanya
PhD Candidate

Virginia Tech | Mechanical Engineering

540 449-7506 | bharathb@vt.edu

From: Gunderson, Jesse <jesse.gunderson@mts.com>
Sent: Monday, November 18, 2024 4:52:53 PM
To: Balasubramanya, Bharath <bharathb@vt.edu>
Subject: RE: Permission to use images from MTS website in PhD thesis - Virginia Tech

Hi, Bharath.

It was nice to talk to you at Auto Test Expo.

I will take this request to the Marketing/Legal team to understand any implications and report back my findings.

Regards,

Jesse

Jesse C. Gunderson, P.E.
Sr. Product Manager
MTS Systems | ITW Corporation
Office: 952-937-4763
Cell: 612-462-0316
jesse.gunderson@mts.com

From: Balasubramanya, Bharath <bharathb@vt.edu>
Sent: Sunday, November 17, 2024 5:00 PM
To: Gunderson, Jesse <jesse.gunderson@mts.com>
Subject: Re: Permission to use images from MTS website in PhD thesis - Virginia Tech

You don't often get email from bharathb@vt.edu. [Learn why this is important](#)

CAUTION: External Email

Please find attached the thesis excerpt that failed to upload correctly in my previous email:

Thank you

Bharath Balasubramanya
PhD Candidate
Virginia Tech | Mechanical Engineering
(540 449-7506 | bharathb@vt.edu)

From: Balasubramanya, Bharath <bharathb@vt.edu>
Sent: Sunday, November 17, 2024 5:58 PM
To: jesse.gunderson@mts.com <jesse.gunderson@mts.com>
Subject: Permission to use images from MTS website in PhD thesis - Virginia Tech

Hello

I am Bharath, an EV Calibration Engineer at Ford Motor company, currently working with a team in the EVEMS organization developing capabilities on a Vehicle-In-Loop hub-coupled powertrain dynos and recently completed my PhD dissertation at Virginia Tech.

Thank you for meeting with me at your booth in the Automotive Testing Expo on Oct 18. It was really interesting and exciting and meet with you to talk about the technologies your company has developed that formed such a large motivation for my PhD thesis. Since then, I have completed my final dissertation which went really well and have completed my doctorate degree in Mechanical engineering with a focus on

adaptive filtering-based control synthesis algorithms for service environment replication, an application tackled at MTS/ServoTest over many decades.

One of my requests during our discussions at the expo was to seek permission for the use of certain images that are available on your website currently, as part of introducing the applications of interest for the thesis. Having completed the final exam, I am currently completing the thesis submission to the library at Virginia Tech, as part of ETD submissions required for every completed thesis/dissertation.

The abstract of my thesis is given below:

Service Environment Replication refers to the process of using test machines to apply controlled dynamic loads to test articles in order to replicate operating conditions that the article was designed for. Such test machines hence require the development of dynamic time series commands that drive the actuators in order to replicate the responses of the actual dynamic system measured separately in its service environment.

A novel adaptive filtering approach, called the Pulse Train Filtered-x Least Mean Square algorithm for waveform generation and drive file identification is proposed in this thesis based on methods developed for Active Noise and Vibration Control. Simulation studies are considered using various test benches with varying degrees of nonlinearity to validate the performance of the proposed algorithm to rapidly converge to a dynamic solution in a small number of iterations. The PT-Fx-LMS algorithm is also shown to enable targeted iteration over isolated time slices within the data set, which challenges conventional iterative DFID techniques. Further modifications to the algorithm are proposed that uses a completely offline workflow using the estimated dynamics of the plant and an empirical termination criterion to improve performance and ensure stability of the adaptive process. The architecture developed is applicable for a wide array of dynamic systems with single or multiple actuators and sensors. Experimental validation of the proposed algorithm is conducted using an acoustic setup to replicate target sound fields for a wide array of configurations.

The context in which I use the images are given in the attached excerpts of the thesis document. The purpose of this section of the first chapter is to motivate the development of novel adaptive filtering based algorithms for Drive File Identification and my intention is to present existing test rigs in use in the industry for Kinematic/Compliance testing, hardware-in-loop shake tables etc. The research over the years has also produced one journal publication in the MDPI Machines journal and can be accessed at the following DOI link: <https://doi.org/10.3390/machines12050286>

Pulse Train Fx-LMS Algorithm for Drive File Identification

A novel time-domain algorithm is proposed in this paper for the iterative estimation of drive files. A drive file is a synchronized batch of dynamic time series commands that are simultaneously sent to one or more actuators in a test rig that is designed for service environment replication (SER). When drive file commands are input to an SER test rig, the response of the article under

doi.org

Overall, the images I request permission for use and the locations where they have been sourced from is given below:

1. MTS Systems' Model 320 Tire-coupled Road Simulator : <https://www.mts.com/en/products/automotive/full-vehicle-test-systems/model-320-tire-coupled-road-simulator>



2. MTS Systems' K&C Deflection Measurement System :

<https://www.mts.com/en/products/automotive/full-vehicle-test-systems/kinematic-compliance-systems#technical>



3. MTS Systems' Multi-Axial Simulation Table (MAST) system :

<https://www.mts.com/en/products/automotive/subsystem-component-test-systems/multi-axial-simulation-table-systems#technical>



I would be really grateful if you could provide permission for the use of these images in my thesis document that will be available through Virginia Tech's ETD library once approved over the next few weeks. I would prefer email communication regarding permission to use these images, and I am hoping that will be sufficient for this purpose, but could eventually need a specific letter for the same.

I highly appreciate your interest shown that day at the expo and look forward to working with you eventually in some context over the course of my career forward.

Thank you

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Thank you

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