October 30th, 2020

MacDonald, Dettwiler and Associates Inc.
9445 Airport Road
Brampton, Ontario
L6S 4J3 Canada

To whom it may concern,

Alex is currently enrolled as a Bachelors of Software Engineering student in the Computing and Software Department at McMaster University. I have worked with Alex in my capacity as Senior Member of Technical Staff- SSRMS Mission Operations Lead at MacDonald Dettwiler and Associates during his 16-month internship at MDA.

In Alex's research at MDA, he applied a novel machine learning technique that results in fast but accurate approximations of Canadarm2 simulation results. These simulations typically take long time spans to run using an MDA-developed SPOTS simulator for high-fidelity modeling. The new approach he devised can accelerate not only our current SPOTS-based analysis techniques but also has application for real-time operation health-monitoring.

Alex started out his internship in the first phase by gaining familiarity with recurrent neural networks (RNNs) and successfully modeled simple maneuvers of the Canadarm2. During the second phase, Alex refined the RNN architecture and applied to model Rate Limit Verification (RLV), where the arm and payload are maneuvered through several worst-case scenarios. RLV verifies that load/stopping distance limits are not violated, and the results are used to adjust the control parameters (e.g., rate limits) of the arm, such that they are appropriate for a mission.

Alex's contribution has given us the capability to obtain accurate predictions for these rate limits without performing extensive tuning iterations using our SPOTS simulator, leading to significant cost savings per analysis. Based on this foundation, the plan now is to extend this approach to forms of analysis that utilize contact dynamics (i.e., using Canadarm2 to berth a payload to the station), and autonomous fault monitoring and recovery.

In the short time at MDA, Alex has displayed a level of curiosity, enthusiasm, and overall excitement for the research he was involved that I have never seen in a student. He works well independently and seeks help once he has exhausted his own abilities. Already in the 16 months working at MDA, his hard work and perseverance have paid off with new tool enhancements that we will regularly use for Canadarm2 analysis. I recommend his candidacy without reservation.

Sincerely,

Nader Abu El Samid
Senior Member of Technical Staff - Controls