

IMPLEMENTATION OF MECHANICAL ASSEMBLY RATING TOOL BASED ON KINEMATIC SCREW THEORY

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STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



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ABSTRACT

IMPLEMENTATION OF MECHANICAL ASSEMBLY RATING TOOL BASED ON KINEMATIC SCREW THEORY

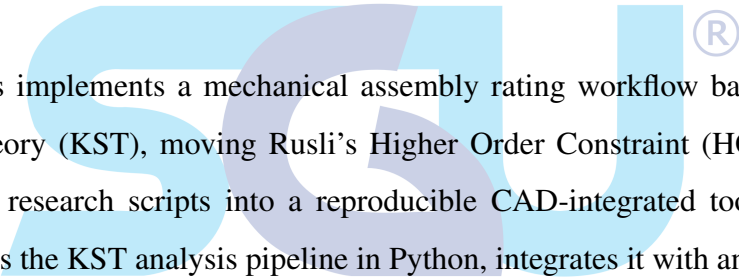
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This thesis implements a mechanical assembly rating workflow based on Kinematic Screw Theory (KST), moving Rusli's Higher Order Constraint (HOC) method from MATLAB research scripts into a reproducible CAD-integrated tool. The work re-implements the KST analysis pipeline in Python, integrates it with an Autodesk Fusion 360 add-in, and defines a JSON v2 contract for translating CAD-selected point, pin, line, and plane constraints into KST-compatible wrench parameters. Numerical parity is established against 21 MATLAB/Octave reference cases. Case-study validation on the end-cap and printer-housing assemblies demonstrates the CAD-to-engine workflow and documents coordinate-selection limits in interactive CAD. For optimization, the thesis focuses on location line-search constraint modification. Constant Interval Search (CIS), Differential Evolution (DE), finite-difference probes, and machine-learning surrogate evidence are compared using the same KST objective. The conclusion is focused: DE can reduce full KST evaluations on relevant line-search cases, while physical interpretation remains in the deterministic KST metrics.

Keywords: Kinematic Screw Theory, Higher Order Constraint, CAD integration, line-search optimization, Differential Evolution.



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DEDICATION

I dedicate this work to my parents, mentors, and all colleagues who supported the completion of this thesis.



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