PhD Proposal Writeup

A realtime and parallel look-ahead control and feedrate compensation strategy for CNC reference-pulse interpolation.

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Abstract

***TO REMOVE LATER**: The abstract is a brief summary of your Ph.D. Research Proposal, and should be no longer than 200 words. It starts by describing in a few words the knowledge domain where your research takes place and the key issues of that domain that offer opportunities for the scientific or technological innovations you intend to explore. Taking those key issues as a background, you then present briefly your research statement, your proposed research approach, the results you expect to achieve, and the anticipated implications of such results on the advancement of the knowledge domain.*

***TO REMOVE LATER**: To keep your abstract concise and objective, imagine that you were looking for financial support from someone who is very busy. Suppose that you were to meet that person at an official reception and that she would be willing to listen to you for no more than two minutes. What you would say to that person, and the pleasant style you would adopt in those two demanding minutes, is what you should put in your abstract. The guidelines provided in this template are meant to be used creatively and not, by any means, as a cookbook recipe for the production of research proposals.*

Keywords

CNC, interpolation, reference-pulse, look-ahead control, feedrate compensation, realtime, realtime processing, parallel computing, parallel algorithm.

***TO REMOVE LATER**: This section is an alphabetically ordered list of the more appropriate words or expressions (up to twelve) that you would introduce in a search engine to find a research proposal identical to yours. The successive keywords are separated by comas.*

Acknowledgement

Bismillahir-Rahmanir-Rahim. Innal hamdulillah, wa nahmaduhu, wa nasta'ienuhu, wa nastaghfiruhu. Wa na'udzubihi, min syururi anfusina, wa min sayyita a'qmalina. Man yahdhihillahu, fala mudhillalah. Wa man yudhlil, fala ha diyalah. Assalamualaikum Warahmatullah Hiwabarokatuh.

In the name of Allah, the Most Merciful and Most Compassionate. Indeed all praises be unto Allah, and we praise Him, and we seek help from Him, and we seek forgiveness from Him. We seek refuge from Him from the evil of ourselves, and from the evil of our actions. Whomsoever Allah guides, none can misguide. And whomsoever He leaves astray, none can guide. May the Peace, Mercy and Blessings of Allah be upon you.

Foremost, I thank Allah, the Most Glorious and Most High, for granting me the opportunity to tread down the unknown trail on this research journey. I wish to also convey my sincerest gratitude to all people who have directly or indirectly, or will be involved with me on this journey. There are just too many people to mention.

Specially to Prof Yashwant Prasad Singh, perceived as many personalities to me: As my guru, teacher, mentor, advisor, supervisor and a dear friend, I am very grateful to him for his unimaginable faith, persistence and enthusiasm in encouraging, guiding, and sharing with me knowledge throughout the many wonderful years of our academic acquaintance. As my Supervisor, his advice was simple, "Your PhD study should be exciting and fun." We spent long hours and fruitful discussions on almost unlimited topics, from philosophy, politics, religion, and family to the hard sciences, computer science, and engineering. We also made a pact to remain as lifelong friends, Insya Allah, God Willing. With internet facilities today, we are constantly in communication.

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To my family, especially my wife, my sons and daughter, I thank them affectionately for their unshakable love, utmost patience, undivided support and unwavering understanding during the long hours and sleepless nights I went through. The coffee and snacks were never interrupted. For smooth English writing, my wife is also my bouncer and editor.

To those in my extended family with PhDs, I thank them admiringly for their strange looks and jokes. One senior poked fun with a comment at me, considered as being the most intelligent among them but does not have a doctorate. My cynical response was, "Is it not inspiring that for many years I have been doing work of people with PhDs but without a doctorate myself? I feel, it is certainly humbling but yet assuring being accorded with that

kind of trust and responsibility."

To my friends, I kindly thank them for all support and encouragement rendered to me during my research journey. To Multimedia University (MMU), I thank them for the opportunity provided to me for teaching, conducting research and the unforgettable interactions with Prof Singh and staff at the university. To University Malaysia Pahang (UMP), I thank them for accepting me as a research student and for the generosity of providing research equipment and resources.

Finally, I again praise Allah, for the invaluable gifts of health, time and clear state of mind, without which, I would not have been able to go through this arduous and exhausting journey. There is always a purpose in everything. Thinking of it, I recalled the motto of a local university, "To Allah and Mankind". Without hesitation, I say, this is exactly the one for me. God Willing, may Allah grant me this deserving wish. In closing, I wish to share the following passages from Allah, the All-Knowing and All-Mighty.

> And in His Providence are the keys of the Unseen; none knows them except He. And He knows whatever is in the land and the sea. And in no way does a leaf fall down, except that He knows it, and not a grain in the darkness of the earth, not a thing wet or dry, except that it is in an evident Book.
>
> Whoever submits his whole self to God and is a doer of good, he has grasped indeed the most trustworthy handhold. And with God rests the end and decision of all affairs.
>
> Verily, When He (Allah) intends a thing, his command is "Be ! and it is !".
>
> (*Al-Quran, Al-An'am 6:59, Lukman 31:22 and Ya-Sin 36:82*)

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1 Simulation Results

1.1 The Parametric Equations

The images of the UMP 3-axis CNC research machine for our previous work are provided in next three figures. It is an experimental CNC router-type, that instead of a tool cutter, uses a pen to create drawings on paper in the X-Y plane. The Z-axis motion is used to raise and lower the pen. As a consequence, circular arc (G02, G03 G-Code) moves are applicable to the X and Y axes only, while linear (G01 G-Code) moves are applicable to all three X, Y and Z axes.

Electrical signal pulses sent to the servo-driver provide information like rotate clockwise (CW), rotate counter-clockwise(CCW), travel distance to rotate, speed to rotate, and so on. The actuation using electrical pulses makes the physical CNC machine instantaneously active.