0 if tex.enableprimitives thenΩtex.enableprimitives(Ω'pdf@',Ω'primitive', 'ifprimitive', 'pdf-draftmode','draftmode'Ω)Ωtex.enableprimitives('', 'luaescapestring')ΩendΩ

MANUSCRIPT TITLE (UP TO 6 INCHES IN WIDTH AND CENTERED, 14 POINT BOLD FONT, MAJUSCULE)

Junette Hsin[*], Daniel Gonzalez[†], and J.Q. Public[‡]

The abstract should briefly state the purpose of the manuscript, the problem to be addressed, the approach taken, and the nature of results or conclusions that can be expected. It should stand independently and tell enough about the manuscript to permit the reader to decide whether the subject is of specific interest. The abstract shall be typed single space, justified, centered, and with a column width of 4.5 inches. The abstract is not preceded by a heading of "Abstract" and its length may not extend beyond the first page.

INTRODUCTION

Paper Title Rendezvous Proximity Operations Equations of Motion Derived with SINDy and Controlled with MPC

Problem statement (general)

The problem of performing orbit maneuvers where two spacecraft converge onto the same orbit is a called a space rendezvous. Two classification groups are generally utilized when describing the spacecraft taking part in these types of missions: target and chaser. The goal in these rendezvous operations is to control the active chaser satellite with the objective to match its orbit velocity and position to that of the passive target satellite (should we place target and chaser in quotes?). Once the chaser gets sufficiently close to the target, it can hold its relative position constant, follow a profile about the objective, or approach the spacecraft for docking (We are assuming constant relative position).

wordsmith Orbital rendezvous with a staellite in staitonary low-earth orbit has been extensively analyzed. Various forms of constrained path planning and optimization have been analyzed using modern optimization and serach techniques, however, as the capability and vaailability of targetting aids for cooperative proximity operations and docking have increased, the nature of the approach problem and the operational constraints during it have changed.

In this paper, we persent a new onboard optimal guidance and targetting approach using Model Predictive control, which explicitly incorporate sthe trajectory constraints associated with this transfer. A novel contribution of this approach is its ability to explicitly handle the trajectory state, control, and mission safety constraints. Model Predictive Control has been used in the process industries in chemical plants and oi lrefineries since the 1980s, but in the new millennium has found

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applications in the space engineering industry. The main advantage of MPC is the fact that is allows the current timeslot to be optimized, while keeping future timeslots into account. MPCs rely on dynamic models of hte process, most often linear empirical models obtained by system identification.

–¿ transition into SINDY *wordsmith*

Rendezvous proximity operations (RPO) are becoming more commonplace as they make servicing missions, etc (Look up what RPO can be used for) increasingly possible. A common challenge when planning an RPO mission is accurately determining, representing, and controlling the attitude, positions, and respective rates of the approaching spacecraft. A useful represention of the position and attitude measurements (pose) is dual . Use sensor data to approximate rendezvous proximity operations (RPO) equations of motion EOMs using SINDy. Implement model predictive control (MPC) with the approximated EOMs.

CAUTION DO NOT PLAGIARIZE A space rendezvous is an orbital maneuver during which two spacecraft, one of which is often a space station, arrive at the same orbit and approach to a very close distance (e.g. within visual contact). Rendezvous requires a precise match of the orbital velocities and position vectors of the two spacecraft, allowing them to remain at a constant distance through orbital station-keeping. Rendezvous may or may not be followed by docking or berthing, procedures which bring the spacecraft into physical contact and create a link between them.

The same rendezvous technique can be used for spacecraft "landing" on natural objects with a weak gravitational field, e.g. landing on one of the Martian moons would require the same matching of orbital velocities, followed by a "descent" that shares some similarities with docking.

The standard technique for rendezvous and docking is to dock an active vehicle, the "chaser", with a passive "target". This technique has been used successfully for the Gemini, Apollo, Apollo/Soyuz, Salyut, Skylab, Mir, ISS, and Tingng programs.[citation needed]

To properly understand spacecraft rendezvous it is essential to understand the relation between spacecraft velocity and orbit. A spacecraft in a certain orbit cannot arbitrarily alter its velocity. Each orbit correlates to a certain orbital velocity. If the spacecraft fires thrusters and increases (or decreases) its velocity it will obtain a different orbit, one that correlates to the higher (or lower) velocity. For circular orbits, higher orbits have a lower orbital velocity. Lower orbits have a higher orbital velocity.

For orbital rendezvous to occur, both spacecraft must be in the same orbital plane, and the phase of the orbit (the position of the spacecraft in the orbit) must be matched. The "chaser" is placed in a slightly lower orbit than the target. The lower the orbit, the higher the orbital velocity. The difference in orbital velocities of chaser and target is therefore such that the chaser is faster than the target, and catches up with it.[citation needed]

Once the two spacecraft are sufficiently close, the chaser's orbit is synchronized with the target's orbit. That is, the chaser will be accelerated. This increase in velocity carries the chaser to a higher orbit. The increase in velocity is chosen such that the chaser approximately assumes the orbit of the target. Stepwise, the chaser closes in on the target, until proximity operations (see below) can be started. In the very final phase, the closure rate is reduced by use of the active vehicle's reaction control system. Docking typically occurs at a rate of 0.1 ft/s (0.030 m/s) to 0.2 ft/s (0.061 m/s).[16] CAUTION DO NOT PLAGIARIZE

Related work Adaptive control with dual quaternions MPC with RPO and dual quaternions SINDy with control

Advantage of our method

One of the biggest challenges introduced by this technology is the need to simultaneously and accurately track both time-varying relative position and attitude references trajectories to avoid collisions between the satellites and achieve mission objectives.

THIS IS A SAMPLE OF A GENERAL SECTION HEADING

Numbering of section headings and paragraphs should be avoided. Major section headings are majuscule, bold, flush (aligned) left, and use the same style san-serif font as the body text. Widow and orphan lines should also be avoided; more than one line of a paragraph should appear at the end or beginning of a page, not one line by itself. A heading should not appear at the bottom of a page without at least two lines of text. Equations, figures, and tables must be sequentially numbered with no repeated numbers or gaps. Excessive white space — such as large gaps before, between, and after text and figures — should be minimal and eliminated where possible.

This Is a Sample of a Secondary (Sub-Section) Heading

Secondary, or sub-section, headings are title case (miniscule lettering with the first letter of major words majuscule), flush left, and bold. Secondary headings use the same serif font style as the body text and, like section headings, should not be numbered. Tertiary headings should be avoided, but if necessary, they are run-in, italic, and end in a period, as illustrated with the next six (6) paragraphs.

$$a = b^2 \tag{1}$$

Equations. Equations are centered with the equation number flush to the right. In the text, these equations should be referenced by name as Eq. (1) or Equation (1) (*e.g.*, not eq. 1, (1), or *Equation 1*). To improve readability, scalar variable names such as a and b^2 are usually italicized when appearing in text and equations.*

Abbreviations. When abbreviations for units of measure are used, lower case without periods is preferred in most instances; *e.g.* ft, yd, sec, ft/sec, *etc*., but in. for inch.

Figures. Illustrations are referenced by name and without formatting embellishments, such as Figure 1, Figure 2, *etc*., or, Figures 3 and 4 (*e.g.*, not figure (1), Fig. 1, Figure 1, *Figure 1*, *etc*.). Each illustration should have a caption unless it is a mere sketch. Single-phrase captions are usually in title case; they are bold 10-point serif font and centered below the figure as shown in Figure 1. An explanatory caption of several sentences is permissible. Ideally, every illustration should be legibly sized – usually about one-half or one-quarter page – and appear in the text just before it is called out or mentioned. Alternatively, it is also permissible to place all figures together at the end of the text as a separate appendix; however, these two conventions should not be mixed. All figures and callouts should remain clearly legible after reduction. All illustrations appear as black and white in the final printing, although colors are retained in the electronic (CD-ROM) version.

Graphic Formats. The highest quality formats are Encapsulated PostScript (EPS) and PDF vector-graphic formats. These formats are recommended for all illustrations, unless they create document files that are excessively large. Specifically, you should change the graphic format or compress the image resolution whenever an illustrated page takes more than two seconds to render onscreen, or, whenever the total manuscript file size starts to approach 5 Mb. Photographs, illustrations that use

*A section on mathematical notation is provided in the sequel.

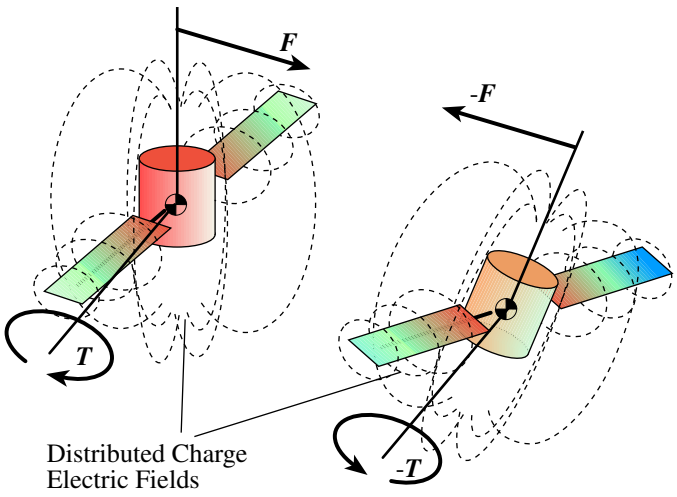

Figure 1. Illustration Caption Goes Here

heavy toner or ink (such as bar graphs), and figures without text callouts, may be suitably displayed with picture formats such as BMP, GIF, JPEG, PNG, TIFF, *etc*. Line drawings, plots, and callouts on illustrations, should not use picture formats that do not provide sharp reproduction. All graphical content must be embedded when creating a PDF document, especially any fonts used within the illustration. Note that the Windows Metafile Format (WMF) is sometimes problematic and should be avoided.

References and Citations. The citation of bibliographical endnote references is indicated in the text by superscripted Arabic numerals, preferably at the end of a sentence.[1,2] If this citation causes confusion in mathematics, or if a superscript is inappropriate for other reasons, this may be alternately expressed as (Reference 1) or (see References 1 and 2), (*e.g.*, not [1], Ref. (1), *etc*.). While there is no singly prescribed format for every bibliographical endnote, references should be consistent in form. Citations should be sufficient to allow the reader to precisely find the information being cited, and should include specific pages, editions, and printing numbers where necessary. URL citations are discouraged, especially when an archival source for the same information is available. If a URL citation is required, it should appear completely and as a footnote instead of a bibliographical reference.* The citation of private communication is especially discouraged, but if required it should be cited as a footnote and include the date, professional affiliation, and location of the person cited.†

Table 1. A Caption Goes Here

Animal	Description	Price ($)
Gnat	per gram	13.65
	each	0.01
Gnu	stuffed	92.50
Emu	stuffed	33.33
Armadillo	frozen	8.99

*`http://www.univelt.com/FAQ.html#SUBMISSION`

†Gangster, Maurice (1999), personal correspondence of March 21st. Sr. Consultant, Space Cowboy Associates, Inc., Colorado Springs, CO.

Tables. Tables are referred to by name in the text as Table 1, or, Tables 2 and 3 (*e.g.*, not table 1, Tbl. 1, or *Table 1*). The title is centered above the table, as shown in Table 1. The font size inside tables should be no larger than the body text, but may be adjusted down to 9-point if necessary (10-point serif font is considered nominal). Note that table units are in parentheses. Only the minimum number of table lines needed for clarity is desired. Ideally, every table should appear within the text just before it is called out, but, it is also permissible to place all tables together at the end of the text as a separate appendix. If so, these two conventions should not be mixed.

Equations, figures, and tables must be sequentially numbered with no repeated numbers or gaps. Each figure and table shall be called out in the text; gratuitous figures and tables that are not called out should be eliminated. Intermediate equations may be numbered without being called out.

MANUSCRIPT SUBMISSION

The Portable Document Format (PDF) is the preferred format for electronic submissions.* The page size should be 8.5 inches by 11 inches exactly. You should use "press-quality" or "high-quality" software settings to create your PDF file; these settings tend to keep the PDF file true to the original manuscript layout, and automatically embed the correct fonts, *etc*. Otherwise, settings such as "Embed All Fonts", *etc*., should be selected as available. The use of internal hyperlinks within the electronic file is not encouraged because hyperlinks may not be supported in the final version of the electronic proceedings.

Journal Submission

If you wish to submit this manuscript to the *Journal of Astronautical Sciences*, it must be re-formatted into a double-spaced format. This can be done easily with this template. At the top of the document, there are two (2) types document class statements (`paper` and `submit`). The first type is the one to use for a conference paper. The second type , which is commented out, can be used to reformat the paper for the JAS journal submission.

CONCLUSION

Some AAS meetings are co-sponsored with the American Institute of Aeronautics and Astronautics (AIAA). When your paper number starts with "AAS", or when the conference is described as a joint "AAS/AIAA" meeting with the AAS listed first, this AAS conference proceedings format shall be used.

Your final manuscript should be camera-ready as submitted — free from technical, typographical, and formatting errors. Manuscripts not suitable for publication are omitted from the final proceedings.

ACKNOWLEDGMENT

Any acknowledgments by the author may appear here. The acknowledgments section is optional.

*By contributing your manuscript for proceedings publication, you necessarily extend any copyrights to the AAS and its designated publisher, to allow the AAS to publish your manuscript content in all the forms that it wishes.

NOTATION

a a real number
b the square root of a

If extensive use of mathematical symbols requires a table of notation, that table may appear here. Where the first mathematical symbol is introduced, a footnote should direct the attention of the reader to this table.* The notation table should be simple and reasonably consistent with the standards of modern technical journals, as illustrated above. The notation table does not need its own caption like an ordinary table, since the section heading serves this purpose. The notation section is optional.

APPENDIX: TITLE HERE

Each appendix is its own section with its own section heading. The title of each appendix section is preceded by "APPENDIX: " as illustrated above, or "APPENDIX A: ", "APPENDIX B: ", *etc*., when multiple appendixes are necessary. Appendices are optional and normally go after references; however, appendices may go ahead of the references section whenever the word processor forces superscripted endnotes to the very end of the document. The contents of each appendix must be called out at least once in the body of the manuscript.

Miscellaneous Physical Dimensions

The page size shall be the American standard of 8.5 inches by 11 inches (216 mm x 279 mm). Margins are as follows: Top – 0.75 inch (19 mm); Bottom – 1.5 inches (38 mm); Left – 1.25 inches (32 mm); Right – 1.25 inch (32 mm). The title of the manuscript starts one inch (25.4 mm) below the top margin. Column width is 6 inches (152.5 mm) and column length is 8.75 inches (222.5 mm). The abstract is 4.5 inches (114 mm) in width, centered, justified, 10 point normal (serif) font.

REFERENCES

[1] J. L. Doe and J. Q. Public, "The Parameterization of the Rotation Matrix using Redundant Attitude Coordinates," *Nonlinear Dynamics*, Vol. 32, No. 3, 2005, pp. 71–92.

[2] *Style Manual*. New York 17, New York: American Institute of Physics, 2nd ed., 1959.

*The footnote symbols are a standard sequence: $*$, †, ‡, *etc*. This sequence of footnote symbols should restart with each new page.