**Reviewer #1**

*We thank the reviewer for their positive review. We are particularly proud by the glowing comment from the reviewer: “among the most interesting papers you have read over the past year”*

**Reviewer #3**

*We also thank Reviewer #3 for their positive review.*

Comment 1: Although the authors make a notorious effort in providing illustrations to help understand the proposed approach, I think that it would help to add in Fig. 1 details on the mapping between the task space and the surface for which this example is built.

*An abstract example was chosen in Fig. 1 to be able to illustrate the problem more clearly. We acknowledge the suggestion of the reviewer and the graph in Fig.1 will be complemented in the final version with an illustration showing a concrete example with manipulator configurations and an object’s surface being covered to add further clarity.*

**Reviewer #4**

Comment 1: I have to admit however that, for the non-expert on this sub-area of motion planning, I believe this paper is currently not easily readable and should be significantly revised with a focus on readability for non-experts and with attention to precision and clarity of claims and definitions. It would help tremendously if the authors would make formal definitions in definition environments, for example to rigorously define "an intersection", as discussed in II A and to also formally put the underlying graph definition in a definition environment. The same holds for the section on defining Strips and to make a formal problem definition in the introduction. Similarly, for claims such as "proofs of complexity", a formal theorem + proof environment would clarify the exposition. Finally, the key algorithm proposed in this work could be condensed into a formal algorithm environment for clarity and precision.

*We appreciate the problem tackled and solution provided in the manuscript is non-trivial for the non-expert. Significant effort was devoted to reach to a wider audience given the relevance of the problem to the robotics community in general by adding a large volume of figures and examples all along, greatly adding to its understanding - as endorsed by the other two reviewers, which appear more versed on the area of research. From the comments of Reviewer #4 we can better appreciate where to add more descriptions and formal definitions with a focus on introducing in self-contained form the background of the work.*

Comment 2: Browsing through the references, it seems that the cited paper [12] may provide much of the required background details, but given limited time and viewing the paper as self-contained, I am unfortunately not able to verify the correctness of the work as a result of uncertainties about the underlying constructions and definitions. For example: Could the authors provide more background on the used cell-decompositions? How do they arise, what kind of cell decompositions are these? CW-complexes? Should cells be contractible? What properties are required of the cells?

*Our prior work [12] is indeed the basis of our submission and provides additional details and background for the problem tackled. Many related terminologies such as “cell”, “cellular decomposition”, the formation and properties of the cells etc. are borrowed from it, were discussed at length in there, and have been included in the present manuscript in limited form to leave room for the in-depth analysis of the additional key contribution: a substantial provable improvement on the computation of the optimal solution to the NCCP problem. We will insert additional definitions within the allowable space to make the paper more self-contained and clear to the non-expert reader as suggested.*

Comment 3: A short formal definition of how cells yield presumably space filling paths on each cell would clarify how this is related to path planning, and how this is achieved in the actual experiments.

*This is nominated at the paper onset in Section I, second paragraph, when the problem is described in the context of a coverage path planning (CPP) task: once the region is separated into cells with simple shapes, any geometric template coverage path (such as Boustrophedon or spiral paths) can be constructed within each cell to achieve full object coverage. Thus, not being an intrinsic component to the NCCP problem solution, detailed visualisation of the geometric coverage paths are omitted in the results section. For the non-specialised reader this may have gone unnoticed, as pointed by the reviewer, and we will incorporate an additional note on this point in the experimental section.*

Comment 4: In the experimental section, it was also not clear to me how the cells and required numerical discretizations were obtained and no time/memory complexity analysis is provided to allow the reader to understand how close the proposed methods are to real-world use readiness. Adding these details would significantly improve the readability of the paper to the general RSS audience.

*We will add more details in this regard on the experimental implementation section in our revised version. Being a manuscript focused on computational improvements for an optimal planning problem, complexity is formally analysed in detail in Section V to reveal such an advancement (order of 2^N, N being the number of graph edges representing the colour choices). Moreover, Table I provides numerical details of the iterations improvement for the two objects used as examples in terms of the proposed optimal solver over the alternative full enumeration approach.*

Comment 5: the current draft should be shortened to 8 pages to conform to the submission guidelines. At the moment there is an overflow due to a citation.

*The current submission complies with the required length limits: content is condensed within 7.5 pages, with only citations going over 8 pages. As such, we have left a bit of allowable space (around half a page) to address any issues or suggestions from the reviewers (notably the additional formal definitions suggested by Reviewer #4).*