# Context-Aware and Physics-Align LLM-Social Force Model (CAPL-SFM) Crowd Simulator

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## Abstract

We present LLM-SFM Translator, a context-aware and physics-aligned framework for trajectory generation and crowd simulation in unseen scenarios. Given scene images and natural-language prompts, the proposed method translates high-level contextual descriptions into physically grounded Social Force Model parameters and agent trajectories. To improve behavioral fidelity and physical consistency, we incorporate reinforcement learning from AI feedback (RL-AIF) to distill reasoning and decision patterns from large language models into a stable translator. We further introduce a novel evaluation framework with a benchmark dataset that combines statistical metrics, agent-level behavioral consistency, LLM-based judgment, and human evaluation. Experiments on standard and unseen environments demonstrate improved generalization, interpretability, and physical plausibility over existing learning-based and controllable simulation baselines.

## 1 Introduction

The *IJCAI–ECAI 26 Proceedings* will be printed from electronic manuscripts submitted by the authors. These must be PDF (*Portable Document Format*) files formatted for 8-1/2″ × 11″ paper.

### 1.1 Length of Papers

All paper *submissions* to the main track must have a maximum of seven pages, plus at most two for references / acknowledgements / contribution statement / ethics statement.

The length rules may change for final camera-ready versions of accepted papers and differ between tracks. Some tracks may disallow any contents other than the references in the last two pages, whereas others allow for any content in all pages. Similarly, some tracks allow you to buy a few extra pages should you want to, whereas others don't.

If your paper is accepted, please carefully read the notifications you receive, and check the proceedings submission information website[1] to know how many pages you can use for your final version. That website holds the most up-to-date information regarding paper length limits at all times.

[1]https://proceedings.ijcai.org/info

### 1.2 Word Processing Software

As detailed below, IJCAI has prepared and made available a set of LaTeX macros and a Microsoft Word template for use in formatting your paper. If you are using some other word processing software, please follow the format instructions given below and ensure that your final paper looks as much like this sample as possible.

## 2 Related Work

LaTeX and Word style files that implement these instructions can be retrieved electronically. (See Section 9 for instructions on how to obtain these files.)

### 2.1 Crowd Simulation

Print manuscripts two columns to a page, in the manner in which these instructions are printed. The exact dimensions for pages are:

- left and right margins: .75″
- column width: 3.375″
- gap between columns: .25″
- top margin—first page: 1.375″
- top margin—other pages: .75″
- bottom margin: 1.25″
- column height—first page: 6.625″
- column height—other pages: 9″

All measurements assume an 8-1/2″ × 11″ page size. For A4-size paper, use the given top and left margins, column width, height, and gap, and modify the bottom and right margins as necessary.

### 2.2 Trajectory Generation

For the production of the electronic manuscript, you must use Adobe's *Portable Document Format* (PDF). A PDF file can be generated, for instance, on Unix systems using `ps2pdf` or on Windows systems using Adobe's Distiller. There is also a website with free software and conversion services: http://www.ps2pdf.com. For reasons of uniformity, use of Adobe's

*Times Roman* font is strongly suggested. In LaTeX2e this is accomplished by writing

```
\usepackage{times}
```

in the preamble.[2]

Additionally, it is of utmost importance to specify the **letter** format (corresponding to 8-1/2″ × 11″) when formatting the paper. When working with `dvips`, for instance, one should specify `-t letter`.

## 2.3 LLM Physics Parameters Translator

In this document, we distinguish between papers submitted for review (henceforth, submissions) and camera-ready versions, i.e., accepted papers that will be included in the conference proceedings. The present document provides information to be used by both types of papers (submissions / camera-ready). There are relevant differences between the two versions. Find them next.

### Anonymity

For the main track and some of the special tracks, submissions must be anonymous; for other special tracks they must be non-anonymous. The camera-ready versions for all tracks are non-anonymous. When preparing your submission, please check the track-specific instructions regarding anonymity.

### Submissions

The following instructions apply to submissions:

- If your track requires submissions to be anonymous, they must be fully anonymized as discussed in the Modifications for Blind Review subsection below; in this case, Acknowledgements and Contribution Statement sections are not allowed.
- If your track requires non-anonymous submissions, you should provide all author information at the time of submission, just as for camera-ready papers (see below); Acknowledgements and Contribution Statement sections are allowed, but optional.
- Submissions must include line numbers to facilitate feedback in the review process . Enable line numbers by uncommenting the command `\linenumbers` in the preamble.
- The limit on the number of content pages is *strict*. All papers exceeding the limits will be desk rejected.

### Camera-Ready Papers

The following instructions apply to camera-ready papers:

- Authors and affiliations are mandatory. Explicit self-references are allowed. It is strictly forbidden to add authors not declared at submission time.
- Acknowledgements and Contribution Statement sections are allowed, but optional.
- Line numbering must be disabled. To achieve this, comment or disable `\linenumbers` in the preamble.
- For some of the tracks, you can exceed the page limit by purchasing extra pages.

[2]You may want to also use the package `latexsym`, which defines all symbols known from the old LaTeX version.

## 2.4 Title and Author Information

Center the title on the entire width of the page in a 14-point bold font. The title must be capitalized using Title Case. For non-anonymous papers, author names and affiliations should appear below the title. Center author name(s) in 12-point bold font. On the following line(s) place the affiliations.

### Author Names

Each author name must be followed by:

- A newline `\\` command for the last author.
- An `\And` command for the second to last author.
- An `\and` command for the other authors.

### Affiliations

After all authors, start the affiliations section by using the `\affiliations` command. Each affiliation must be terminated by a newline `\\` command. Make sure that you include the newline after the last affiliation, too.

### Mapping Authors to Affiliations

If some scenarios, the affiliation of each author is clear without any further indication (*e.g.*, all authors share the same affiliation, all authors have a single and different affiliation). In these situations you don't need to do anything special.

In more complex scenarios you will have to clearly indicate the affiliation(s) for each author. This is done by using numeric math superscripts `${^i, j, ...}$`. You must use numbers, not symbols, because those are reserved for footnotes in this section (should you need them). Check the authors definition in this example for reference.

### Emails

This section is optional, and can be omitted entirely if you prefer. If you want to include e-mails, you should either include all authors' e-mails or just the contact author(s)' ones.

Start the e-mails section with the `\emails` command. After that, write all emails you want to include separated by a comma and a space, following the order used for the authors (*i.e.*, the first e-mail should correspond to the first author, the second e-mail to the second author and so on).

You may "contract" consecutive e-mails on the same domain as shown in this example (write the users' part within curly brackets, followed by the domain name). Only e-mails of the exact same domain may be contracted. For instance, you cannot contract "person@example.com" and "other@test.example.com" because the domains are different.

### Modifications for Blind Review

When submitting to a track that requires anonymous submissions, in order to make blind reviewing possible, authors must omit their names, affiliations and e-mails. In place of names, affiliations and e-mails, you can optionally provide the submission number and/or a list of content areas. When referring to one's own work, use the third person rather than the first person. For example, say, "Previously, Gottlob [1992] has shown that…", rather than, "In our previous work [Gottlob, 1992], we have shown that…" Try to avoid including any information in the body of the paper or references that would

identify the authors or their institutions, such as acknowledgements. Such information can be added post-acceptance to be included in the camera-ready version. Please also make sure that your paper metadata does not reveal the authors' identities.

## 2.5 Social Force Model

Place the abstract at the beginning of the first column 3″ from the top of the page, unless that does not leave enough room for the title and author information. Use a slightly smaller width than in the body of the paper. Head the abstract with "Abstract" centered above the body of the abstract in a 12-point bold font. The body of the abstract should be in the same font as the body of the paper.

The abstract should be a concise, one-paragraph summary describing the general thesis and conclusion of your paper. A reader should be able to learn the purpose of the paper and the reason for its importance from the abstract. The abstract should be no more than 200 words long.

## 2.6 Text

The main body of the text immediately follows the abstract. Use 10-point type in a clear, readable font with 1-point leading (10 on 11).

Indent when starting a new paragraph, except after major headings.

## 2.7 Headings and Sections

When necessary, headings should be used to separate major sections of your paper. (These instructions use many headings to demonstrate their appearance; your paper should have fewer headings.). All headings should be capitalized using Title Case.

### Section Headings

Print section headings in 12-point bold type in the style shown in these instructions. Leave a blank space of approximately 10 points above and 4 points below section headings. Number sections with Arabic numerals.

### Subsection Headings

Print subsection headings in 11-point bold type. Leave a blank space of approximately 8 points above and 3 points below subsection headings. Number subsections with the section number and the subsection number (in Arabic numerals) separated by a period.

### Subsubsection Headings

Print subsubsection headings in 10-point bold type. Leave a blank space of approximately 6 points above subsubsection headings. Do not number subsubsections.

**Titled paragraphs.** You should use titled paragraphs if and only if the title covers exactly one paragraph. Such paragraphs should be separated from the preceding content by at least 3pt, and no more than 6pt. The title should be in 10pt bold font and to end with a period. After that, a 1em horizontal space should follow the title before the paragraph's text.

In LaTeX titled paragraphs should be typeset using

```
\paragraph{Title.} text.
```

## 2.8 Special Sections

### Appendices

You may move some of the contents of the paper into one or more appendices that appear after the main content, but before references. These appendices count towards the page limit and are distinct from the supplementary material that can be submitted separately through CMT. Such appendices are useful if you would like to include highly technical material (such as a lengthy calculation) that will disrupt the flow of the paper. They can be included both in papers submitted for review and in camera-ready versions; in the latter case, they will be included in the proceedings (whereas the supplementary materials will not be included in the proceedings). Appendices are optional. Appendices must appear after the main content. Appendix sections must use letters instead of Arabic numerals. In LaTeX, you can use the `\appendix` command to achieve this followed by `\section{Appendix}` for your appendix sections.

### Ethical Statement

Ethical Statement is optional. You may include an Ethical Statement to discuss the ethical aspects and implications of your research. The section should be titled *Ethical Statement* and be typeset like any regular section but without being numbered. This section may be placed on the References pages.

Use

```
\section*{Ethical Statement}
```

### Acknowledgements

Acknowledgements are optional. In the camera-ready version you may include an unnumbered acknowledgments section, including acknowledgments of help from colleagues, financial support, and permission to publish. This is not allowed in the anonymous submission. If present, acknowledgements must be in a dedicated, unnumbered section appearing after all regular sections but before references. This section may be placed on the References pages.

Use

```
\section*{Acknowledgements}
```

to typeset the acknowledgements section in LaTeX.

### Contribution Statement

Contribution Statement is optional. In the camera-ready version you may include an unnumbered Contribution Statement section, explicitly describing the contribution of each of the co-authors to the paper. This is not allowed in the anonymous submission. If present, Contribution Statement must be in a dedicated, unnumbered section appearing after all regular sections but before references. This section may be placed on the References pages.

Use

```
\section*{Contribution Statement}
```

to typeset the Contribution Statement section in LaTeX.

### References

The references section is headed "References", printed in the same style as a section heading but without a number. A sample list of references is given at the end of these instructions. Use a consistent format for references. The reference list should not include publicly unavailable work.

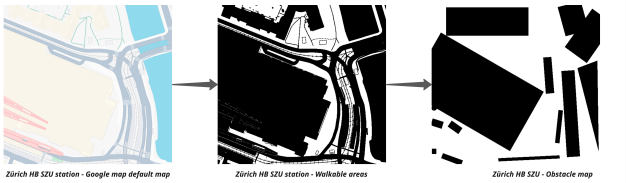


Figure 1: Real world map to obstacle map.

### Order of Sections

Sections should be arranged in the following order:

1. Main content sections (numbered)
2. Appendices (optional, numbered using capital letters)
3. Ethical statement (optional, unnumbered)
4. Acknowledgements (optional, unnumbered)
5. Contribution statement (optional, unnumbered)
6. References (required, unnumbered)

## 2.9 Citations

Citations within the text should include the author's last name and the year of publication, for example [Gottlob, 1992]. Append lowercase letters to the year in cases of ambiguity. Treat multiple authors as in the following examples: [Abelson *et al.*, 1985] or [Baumgartner *et al.*, 2001] (for more than two authors) and [Brachman and Schmolze, 1985] (for two authors). If the author portion of a citation is obvious, omit it, e.g., Nebel [2000]. Collapse multiple citations as follows: [Gottlob *et al.*, 2002; Levesque, 1984a].

## 2.10 Footnotes

Place footnotes at the bottom of the page in a 9-point font. Refer to them with superscript numbers.[3] Separate them from the text by a short line.[4] Avoid footnotes as much as possible; they interrupt the flow of the text.

# 3 Methodology

## 3.1 Dataset Creation

To get a dataset that could demonstrate crowd in public area, we scripted around 100 world famous public places maps including tourists-heavy area, stadiums, university campus and public transportation hub. We then implemented an image to obstacle data processing pipeline using the colormap provided by Google Map official API as well as segmentation model and Polygon approximity algorithm.

# 4 Evaluation

Tables are treated as illustrations containing data. Therefore, they should also appear floated to the top (preferably) or bottom of the page, and with the captions below them.

If you are using LaTeX, you should use the `booktabs` package, because it produces tables that are better than the standard ones. Compare Tables 1 and 2. The latter is clearly more readable for three reasons:

1. The styling is better thanks to using the `booktabs` rulers instead of the default ones.
2. Numeric columns are right-aligned, making it easier to compare the numbers. Make sure to also right-align the corresponding headers, and to use the same precision for all numbers.
3. We avoid unnecessary repetition, both between lines (no need to repeat the scenario name in this case) as well as in the content (units can be shown in the column header).

| Scenario | $\delta$ | Runtime |
|---|---|---|
| Paris | 0.1s | 13.65ms |
| Paris | 0.2s | 0.01ms |
| New York | 0.1s | 92.50ms |
| Singapore | 0.1s | 33.33ms |
| Singapore | 0.2s | 23.01ms |

Table 1: Latex default table

| Scenario | $\delta$ (s) | Runtime (ms) |
|---|---|---|
| Paris | 0.1 | 13.65 |
| | 0.2 | 0.01 |
| New York | 0.1 | 92.50 |
| Singapore | 0.1 | 33.33 |
| | 0.2 | 23.01 |

Table 2: Booktabs table

# 5 Results

IJCAI's two-column format makes it difficult to typeset long formulas. A usual temptation is to reduce the size of the formula by using the `small` or `tiny` sizes. This doesn't work correctly with the current LaTeX versions, breaking the line spacing of the preceding paragraphs and title, as well as the equation number sizes. The following equation demonstrates the effects (notice that this entire paragraph looks badly formatted, and the line numbers no longer match the text):

$$x = \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i \quad (1)$$

Reducing formula sizes this way is strictly forbidden. We **strongly** recommend authors to split formulas in multiple lines when they don't fit in a single line. This is the easiest approach to typeset those formulas and provides the most readable output

$$x = \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \\ + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i. \quad (2)$$

If a line is just slightly longer than the column width, you may use the `resizebox` environment on that equation. The

[3] This is how your footnotes should appear.

[4] Note the line separating these footnotes from the text.

result looks better and doesn't interfere with the paragraph's line spacing:

$$x = \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i. \tag{3}$$

This last solution may have to be adapted if you use different equation environments, but it can generally be made to work. Please notice that in any case:

- Equation numbers must be in the same font and size as the main text (10pt).
- Your formula's main symbols should not be smaller than small text (9pt).

For instance, the formula

$$x = \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j + \prod_{i=1}^{n}\sum_{j=1}^{n} j_i + \prod_{i=1}^{n}\sum_{j=1}^{n} i_j \tag{4}$$

would not be acceptable because the text is too small.

# 6 Ablation Study

Examples, definitions, theorems, corollaries and similar must be written in their own paragraph. The paragraph must be separated by at least 2pt and no more than 5pt from the preceding and succeeding paragraphs. They must begin with the kind of item written in 10pt bold font followed by their number (e.g.: **Theorem 1**), optionally followed by a title/summary between parentheses in non-bold font and ended with a period (in bold). After that the main body of the item follows, written in 10 pt italics font (see below for examples).

In LaTeX we strongly recommend that you define environments for your examples, definitions, propositions, lemmas, corollaries and similar. This can be done in your LaTeX preamble using `\newtheorem` – see the source of this document for examples. Numbering for these items must be global, not per-section (e.g.: Theorem 1 instead of Theorem 6.1).

**Example 1** (How to write an example)**.** *Examples should be written using the example environment defined in this template.*

**Theorem 1.** *This is an example of an untitled theorem.*

You may also include a title or description using these environments as shown in the following theorem.

**Theorem 2** (A titled theorem)**.** *This is an example of a titled theorem.*

# 7 Discussion

Proofs must be written in their own paragraph(s) separated by at least 2pt and no more than 5pt from the preceding and succeeding paragraphs. Proof paragraphs should start with the keyword "Proof." in 10pt italics font. After that the proof follows in regular 10pt font. At the end of the proof, an unfilled square symbol (qed) marks the end of the proof.

In LaTeX proofs should be typeset using the `\proof` environment.

*Proof.* This paragraph is an example of how a proof looks like using the `\proof` environment. □

**Algorithm 1** Example algorithm

**Input**: Your algorithm's input
**Parameter**: Optional list of parameters
**Output**: Your algorithm's output

Let $t = 0$.
**while** condition **do**
  Do some action.
  **if** conditional **then**
    Perform task A.
  **else**
    Perform task B.
  **end if**
**end while**
**return** solution

# 8 Conclusion

Algorithms and listings are a special kind of figures. Like all illustrations, they should appear floated to the top (preferably) or bottom of the page. However, their caption should appear in the header, left-justified and enclosed between horizontal lines, as shown in Algorithm 1. The algorithm body should be terminated with another horizontal line. It is up to the authors to decide whether to show line numbers or not, how to format comments, etc.

In LaTeX algorithms may be typeset using the `algorithm` and `algorithmic` packages, but you can also use one of the many other packages for the task.

# 9 LaTeX and Word Style Files

The LaTeX and Word style files are available on the IJCAI–ECAI 26 website, https://2026.ijcai.org/. These style files implement the formatting instructions in this document.

The LaTeX files are `ijcai26.sty` and `ijcai26.tex`, and the BibTeX files are `named.bst` and `ijcai26.bib`. The LaTeX style file is for version 2e of LaTeX, and the BibTeX style file is for version 0.99c of BibTeX (*not* version 0.98i).

The Microsoft Word style file consists of a single file, `ijcai26.docx`.

These Microsoft Word and LaTeX files contain the source of the present document and may serve as a formatting sample.

Further information on using these styles for the preparation of papers for IJCAI–ECAI 26 can be obtained by contacting `proceedings@ijcai.org`.

# Ethical Statement

There are no ethical issues.

# Acknowledgments

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## References

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