MPT ANALYSIS

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# The Project

The Multiple Particle Tracking Analysis application intends to make Brownian motion analysis easy, fast, and user-friendly.

It has 2 main goals:

* Fast, easy, and user-friendly data analysis
* Easy and user-friendly report export

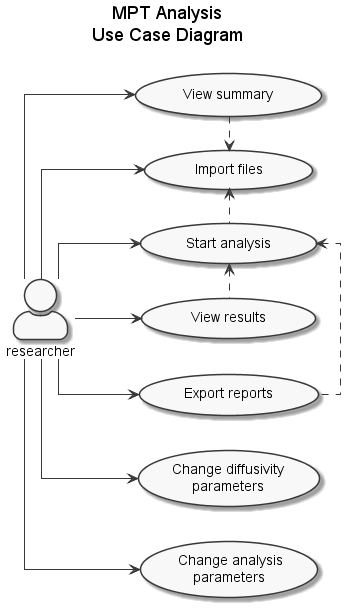
Besides the above, there is also a secondary intention to perform video analysis in such way that it can drop the user of other application, as ImageJ, and make the whole process even easier.

The main requirements of the app are:

1. Allow the user to change parameters according to the video details.
2. Accept ImageJ trajectory reports as data input.
3. Inform the user of the number of trajectories of each imported file.
4. Inform the user of the number of valid trajectories of each imported file.
5. Perform analysis of the data to compute:
   1. Mean Squared Displacement (MSD)
   2. Average MSD (<MSD>)
   3. Diffusivity coefficient (Deff)
   4. Average Diffusivity coefficient (<Deff>)
6. Export reports in MS Excel format:
   1. Individual Analysis: Analysis data of each particle’s trajectory, its MSD and Deff, as well as the <MSD> and <Deff>.
   2. Transport Mode Analysis: Analysis data from Individual Analysis converted to LOG-LOG scale, slope calculation for each trajectory and aa summary of the transport mode classification (immobile, sub-diffusive, diffusive, active).
   3. Stokes-Einstein:

# Use Cases

## Project use case diagram



## Explanation of Use Case Contents

Use Case formats and contents may vary based on system requirements, organizational standards, or unique situations. However, a majority of Use Cases consist of some fundamental contents which may be applied across a wide range of system types. This section will provide explanations for each section of the Use Case.

**Name of Use Case**: Provide a short name for the use case which should lend itself to the objective of the system.

**Description**: This section should provide a description of both the reason for using the use case and the expected outcome of the use case.

**Actors**: Actors may be primary or secondary. Primary actors are the people who will be initiating the system described in the use case. Secondary actors are those will participate in the completion of the use case.

**Precondition**: This section should describe any conditions that must be true or activities that must be completed prior to executing the use case.

**Postcondition**: This section should describe the state of the system at the conclusion of the use case. Postconditions may include conditions for both successful and unsuccessful execution of the use case.

**Flow**: This section should describe all actions of the user and the expected system responses for planned normal execution of the use case. The description should be sequential and provide adequate detail to understand all user actions and system responses.

**Alternative Flows**: Many use cases have varying or special extensions or conditions which are separate from the main flow but also necessary. Alternative flows are usually the result of options or exceptions built into the use case which may alter the primary flow.

**Exceptions**: When use cases are executed, there may be various conditions which result in errors. This section should describe any errors that may result during use case execution and how the system will react or respond to those errors.

**Requirements**: This section should describe any non-functional or special requirements for the system as the use case is executed. These requirements may consist of legal or regulatory requirements, quality standards, or organizational requirements that are outside of the functional requirements the system is expected to perform.

## Use case 1: Import data.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **Import data** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/02/23** | **Last revision date:** | **2021/03/02** |
| **Description:** | Researcher imports ImageJ report data for analysis. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | 1. Researcher has acquired the video files from microscope. 2. The video analysis was performed in ImageJ, using the Mosaic plugin. 3. The researcher has exported the video analysis results in CSV format. | | |
| **Postconditions:** | 1. Researcher can perform analysis. | | |
| **Flow:** | 1. Researcher imports report file(s). 2. The system validates each imported report file. 3. The system summarizes total trajectories and valid trajectories for each imported file. 4. The system computes the summary totals. 5. The system presents the summary information to the researcher. | | |
| **Alternative flows:** | In step 2 of the normal flow, if there is no report file to import:  1. The system does not present the summary. | | |
| **Exceptions:** | N/A | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  N/A | | |

## Use case 2: View summary.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **View summary** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/02/23** | **Last revision date:** | **2021/03/02** |
| **Description:** | Researcher views summary of imported data. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | 1. Researcher has successfully imported ImageJ report files. | | |
| **Postconditions:** | 1. Researcher can perform analysis. | | |
| **Flow:** | 1. Researcher requests to see the summary. 2. The system presents the summary information to the researcher. | | |
| **Alternative flows:** | In step 2 of the normal flow, if there is no summary to present:   1. The system does not present the summary. 2. The system offers a way for the researcher to import ImageJ report files | | |
| **Exceptions:** | In step 2 of the normal flow, if there is no data to show:  1. The system displays a message and allow the user to import data. | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  There must be data already imported. | | |

## Use case 3: Start analysis.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **Start analysis** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/03/02** | **Last revision date:** | **2021/03/02** |
| **Description:** | Research starts the data analysis of the existent data. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | 1. Researcher has successfully imported ImageJ report files. | | |
| **Postconditions:** | 1. Researcher can view and export analysis results. | | |
| **Flow:** | 1. Researcher requests the analysis to start. 2. The system computes the mean squared displacement (MSD). 3. The system computes the mean MSD (<MSD>). 4. The system computes the diffusivity coefficient (Deff). 5. The system computes the mean diffusivity coefficient (<Deff>). 6. The system computes the slopes (α) for each particle’s trajectory. 7. The system shows the results to the researcher. | | |
| **Alternative flows:** | N/A. | | |
| **Exceptions:** | In step 2 of the normal flow, if there are any wrong value:  1. The system throws an error. | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  N/A | | |

## Use case 4: View results.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **View results** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/03/03** | **Last revision date:** | **2021/03/03** |
| **Description:** | Research views the analysis result data and graphs. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | Researcher has performed the analysis | | |
| **Postconditions:** | N/A | | |
| **Flow:** | 1. Researcher requests to view analysis results. 2. The system reads the result data. 3. The system creates charts based on the results data. 4. The system presents the result data to the researcher. 5. The system presents the charts to the researcher. | | |
| **Alternative flows:** | N/A | | |
| **Exceptions:** | N/A | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  N/A | | |

## Use case 5: Export results.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **Export results** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/03/03** | **Last revision date:** | **2021/03/03** |
| **Description:** | Research views the analysis result data and graphs. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | Researcher has performed the analysis | | |
| **Postconditions:** | N/A | | |
| **Flow:** | 1. Researcher requests to export the analysis results. 2. The system reads the result data to the researcher. 3. The system asks the researcher for the location to save the reports. 4. The researcher informs the desired report location. 5. The system creates the results data reports. 6. The system exports the reports to the selected location. | | |
| **Alternative flows:** | N/A | | |
| **Exceptions:** | N/A | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  N/A | | |

## Use case 6: Change diffusivity parameters.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **Change diffusivity parameters** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/03/03** | **Last revision date:** | **2021/03/03** |
| **Description:** | Researcher changes the diffusivity parameters, used to classify the particles/trajectories as *immobile*, *sub-diffusive*, *diffusive,* or *active*. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | N/A | | |
| **Postconditions:** | N/A | | |
| **Flow:** | 1. The researcher changes one or more diffusivity parameters. 2. The researcher requests to save the changes. 3. The system validates the new parameter’s values. 4. The system updates the analysis parameters. | | |
| **Alternative flows:** | In step 2 of the normal flow, if the researcher might not ask to save the changes:  1. The system will take no action. | | |
| **Exceptions:** | N/A | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  N/A | | |

## Use case 7: Change analysis parameters.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Use Case:** | **Change analysis parameters** | | |
| **Created by:** | **Leandro Gabriel** | **Last updated by:** | **Leandro Gabriel** |
| **Date created:** | **2021/03/03** | **Last revision date:** | **2021/03/03** |
| **Description:** | Researcher changes the analysis parameters, used in the *MSD*, *<MSD>*, *Deff*, and *<Deff>* calculations. | | |
| **Actors:** | Researcher | | |
| **Preconditions:** | N/A | | |
| **Postconditions:** | N/A | | |
| **Flow:** | 1. The researcher changes one or more analysis parameters. 2. The researcher requests to save the changes. 3. The system validates the new parameter’s values. 4. The system updates the analysis parameters. | | |
| **Alternative flows:** | In step 2 of the normal flow, if the researcher might not ask to save the changes:   1. The system will take no action.   In step 4 of the normal flow, if the researcher changes a value that relates to the summary calculations:   1. The system computes the new values of the summary total trajectories and valid trajectories for each imported file. | | |
| **Exceptions:** | N/A | | |
| **Requirements:** | The following requirements must be met before execution of the use case:  N/A | | |