Work Summary: Automated Pose Classification & Video Annotation

Period: August 4, 2025 – February 28, 2026
Participant: Dr. Liubov Revutska
Project Location: The Sense Innovation and Research Center / CHUV
GitHub Repository: `video_annotation_system`

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1. Video Processing & Pose Extraction

Developed a modular, production-ready Python pipeline for clinical video analysis:

- **Core Technologies:** Pose estimation (MediaPipe/psifx), object tracking (SAMURAI/YOLO), and feature engineering.
- **Pipeline Features:** Automated video trimming based on annotation timestamps and temporal feature extraction.
- **Quantitative Results:** Processed 15 video projects, extracting structured pose data and segmentation features.

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2. Processed Dataset Overview

The dataset contains multiple participants and sessions annotated for clinical behavioral markers:

Participant #	Sessions Processed	Output Format	Status
14–16 (Example)	Early (7, 6, 10) & Late (20, 20, 20)	.csv / .tar.gz	Completed
Total: 15 Videos	Full Pipeline Run	JSON & Labeled CSV	Archived

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3. File Storage & Handover

All files follow the established team directory structure on Google Drive:

- **Raw Pose Data:** Archives (.tar.gz) with standardized JSON keypoints per frame.
- **Analysis Results:** Processed CSVs with movement speed, inter-person distance, and posture clusters.
- **Visualizations:** Graphs of feature importance and model metrics (XGBoost/Random Forest).
- **Handover Path:** `Shared Drive > [Project Name] > Analysis > Output_20260224`

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4. Framework Version & Rerun Notes

- **Update Consideration:** Framework update 2 weeks ago may require a batch rerun to align with new schema.
- **Rerun Method:** Config-driven via `src/configs/config.yaml`. Existing JSON archives can be reused to bypass re-tracking.
- **The repository video_annotation_system** has been restructured into a modular format to improve maintability. While the core logic is preserved from the verified Jupyter Notebooks, the full automated pipeline execution via `src/pipeline/full_pipeline.py` may require final environments-specific path adjustments.

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5. Model & Performance Summary

Architecture: Ensemble learning using XGBoost and Random Forest for behavioral marker classification based on pose features.

Key Metrics:

- **Classification Accuracy:** High precision in distinguishing therapist and child movements, and specific postural patterns.
- **F1-Score:** Strong across behavioral classes, balancing precision and recall despite clinical video noise.
- **Feature Importance:**
  - *Movement Dynamics:* Velocity and acceleration of wrists and shoulders most predictive.
  - *Spatial Relationships:* Inter-person distance and torso orientation strongly contributed to engagement classification.

Technical Validation:

- **Cross-Validation:** K-fold cross-validation confirmed generalizability across participants (Sessions 14–16).
- **Pipeline Stability:** Automated alignment of ML-coded features with human-coded annotations provided consistent supervised learning results.

Outputs Generated:

- Feature importance plots (`outputs/`).
- Confusion matrices for behavioral class predictions.
- Comprehensive model metrics in JSON format for further statistical analysis.

- The Sense Retreat Poster