

**S&T Campaign: Information Sciences**  
System Intelligence and Intelligent Systems

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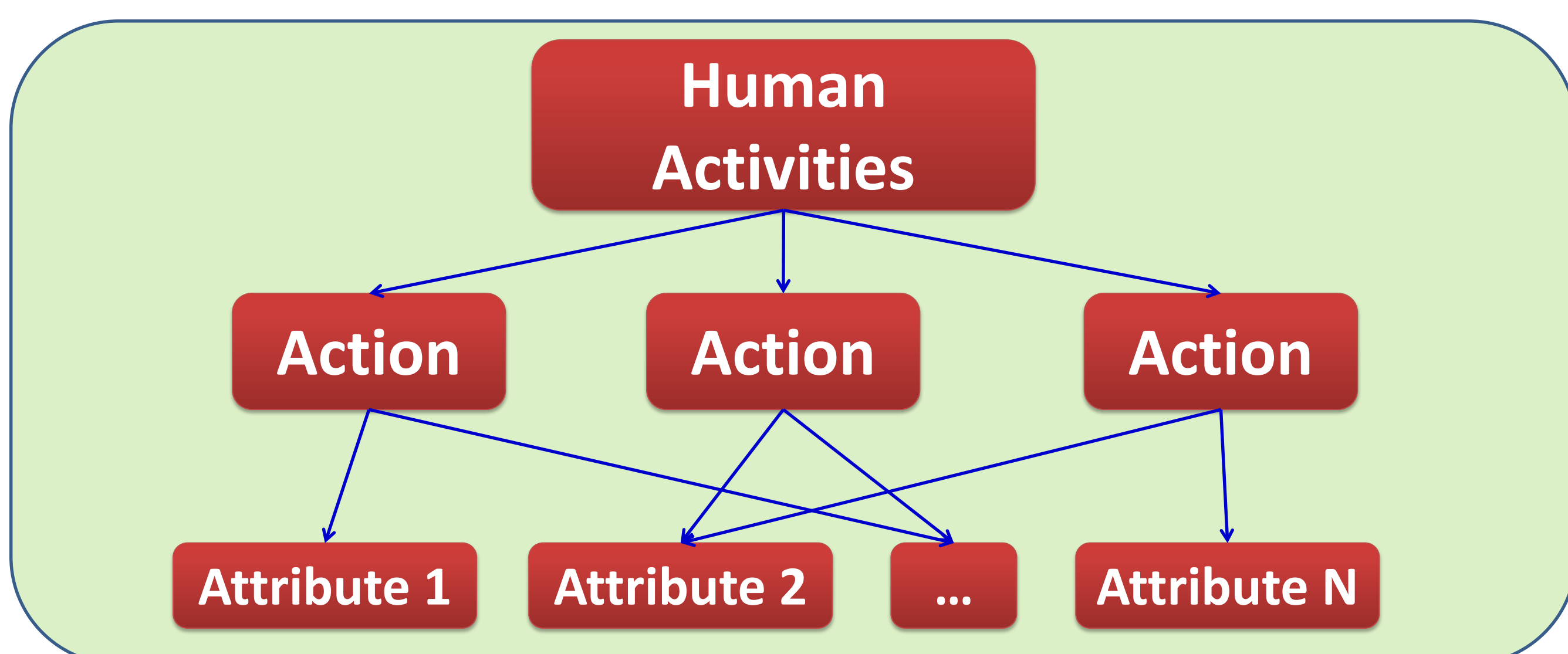
## Research Objective

- Perception and recognition of human activities in videos by learning human body movements or action attributes.
- Benefits:
  - Obtain situational awareness through autonomous systems.
  - Facilitating human-robot teaming efforts.



## Challenges

- Most of the existing algorithms for learning human action attributes are supervised
  - Manually define the attributes and assign training data for each.
  - Manually annotate videos by labeling movements (action attributes).
- Manual annotation is time consuming, if not impossible, for large training datasets.
- Hypothesis: Human action attributes from a collection of high-dimensional video sequences of human activities lie on a union of low-dimensional subspaces.
- A hierarchical union-of-subspaces model to learn and represent the human action attributes.
- A constrained low-rank representation (LRR) based algorithm to learn human action attributes from large streams of video data in an unsupervised manner.



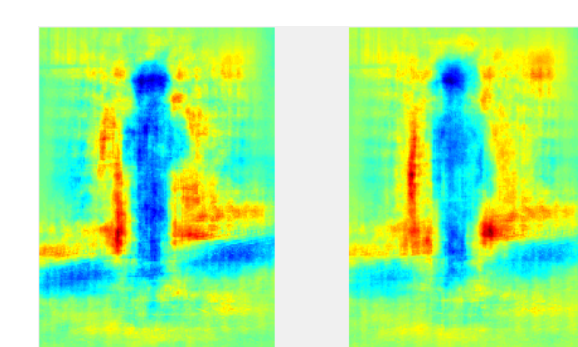
## ARL Facilities and Capabilities Available to Support Collaborative Research

- Video sensors aboard autonomous systems for data collection.
- Various custom-built computing platforms and software packages to support experimentation.

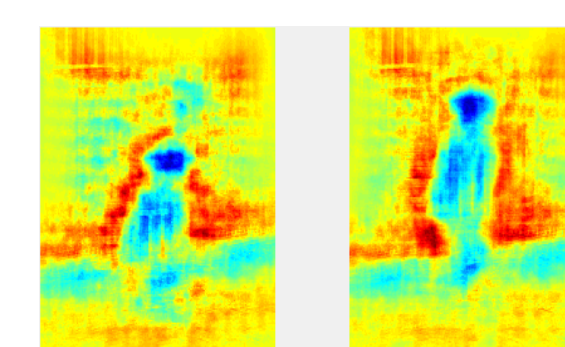
### Application 1: Action Recognition

	HCS-LRR	LRR- $L_p$	LRR-B	SSC- $L_p$	SSC-B	SC-LRR- $L_p$	SC-LRR-B	LSR- $L_p$	LSR-B
Weizmann(HOG)	95.56	82.22	66.67	64.44	51.11	68.89	68.89	71.11	72.22
Weizmann(MBH)	91.11	88.89	66.67	86.67	65.56	90.00	72.22	90.00	73.33
Ballet(HOG)	71.19	54.24	32.20	52.54	38.98	45.76	49.15	40.68	45.76
Ballet(MBH)	71.19	69.49	61.02	54.24	20.34	61.02	62.71	67.80	67.80
Keck(MBH)	90.48	76.98	74.60	78.57	73.81	84.92	84.13	70.63	69.05
UCFsports(MBH)	75.81	75.00	57.26	75.81	53.23	73.39	45.16	68.55	50.00

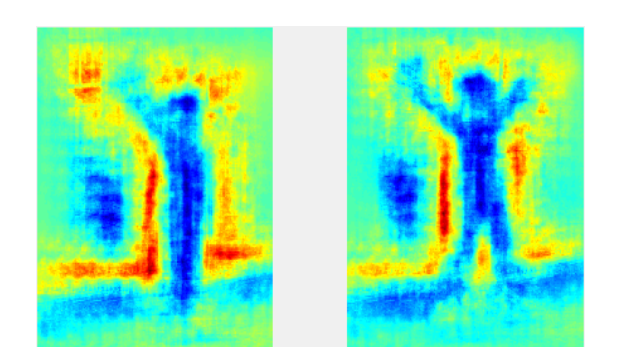
### Application 2: Semantic Summarization



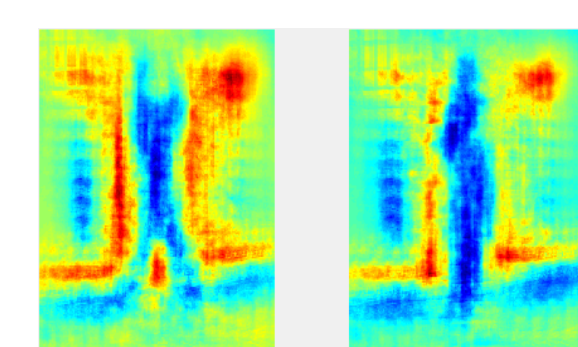
(a) Stand/Clapping



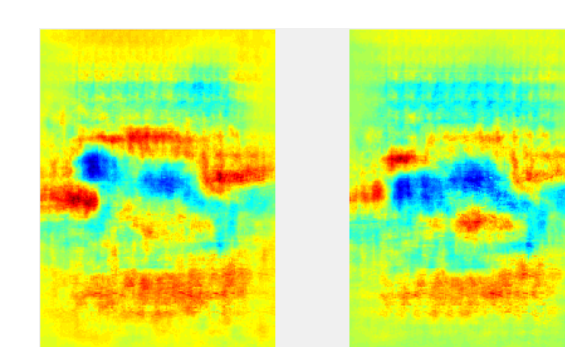
(b) Knee bend



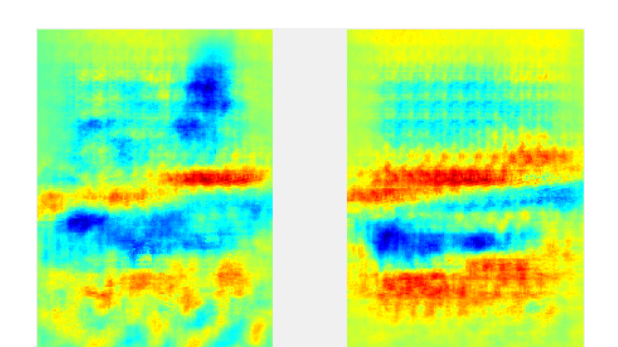
(c) Wave/Jumping jack



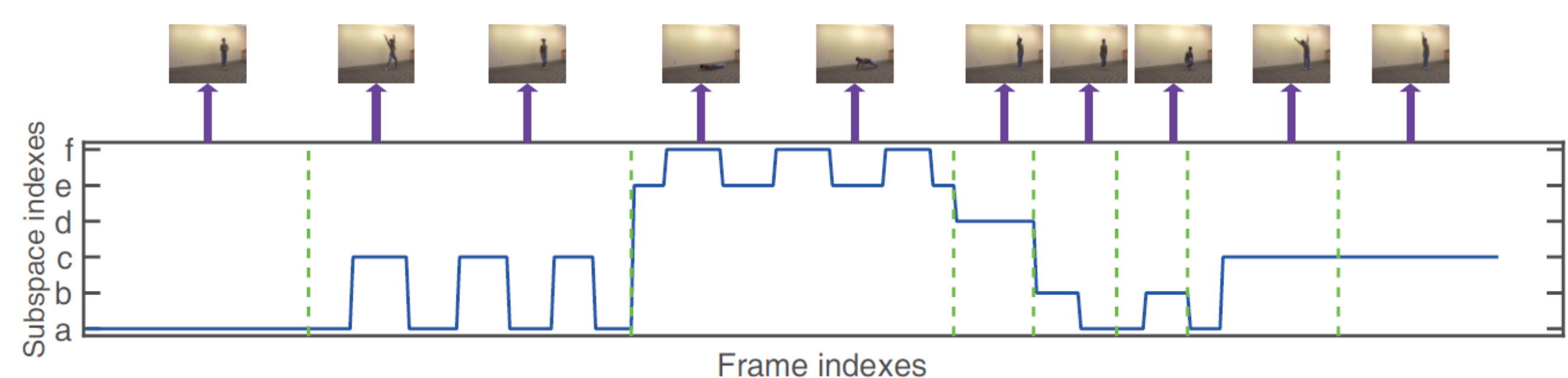
(d) Stretching out/Stand with one hand up



(e) Upper position of push up



(f) Lower position of push up



## Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Internships and Post-doctoral positions available for candidates with expertise in computer vision (CV):
  - Development of Neural Network based detection and recognition algorithms.
  - Optimization and fast implementation of CV algorithms.
- New datasets collected in scenarios exhibiting large variations to test the action recognition algorithm.