3D Face Dynamic Sequences Analysis for Unconstrained Face Recognition

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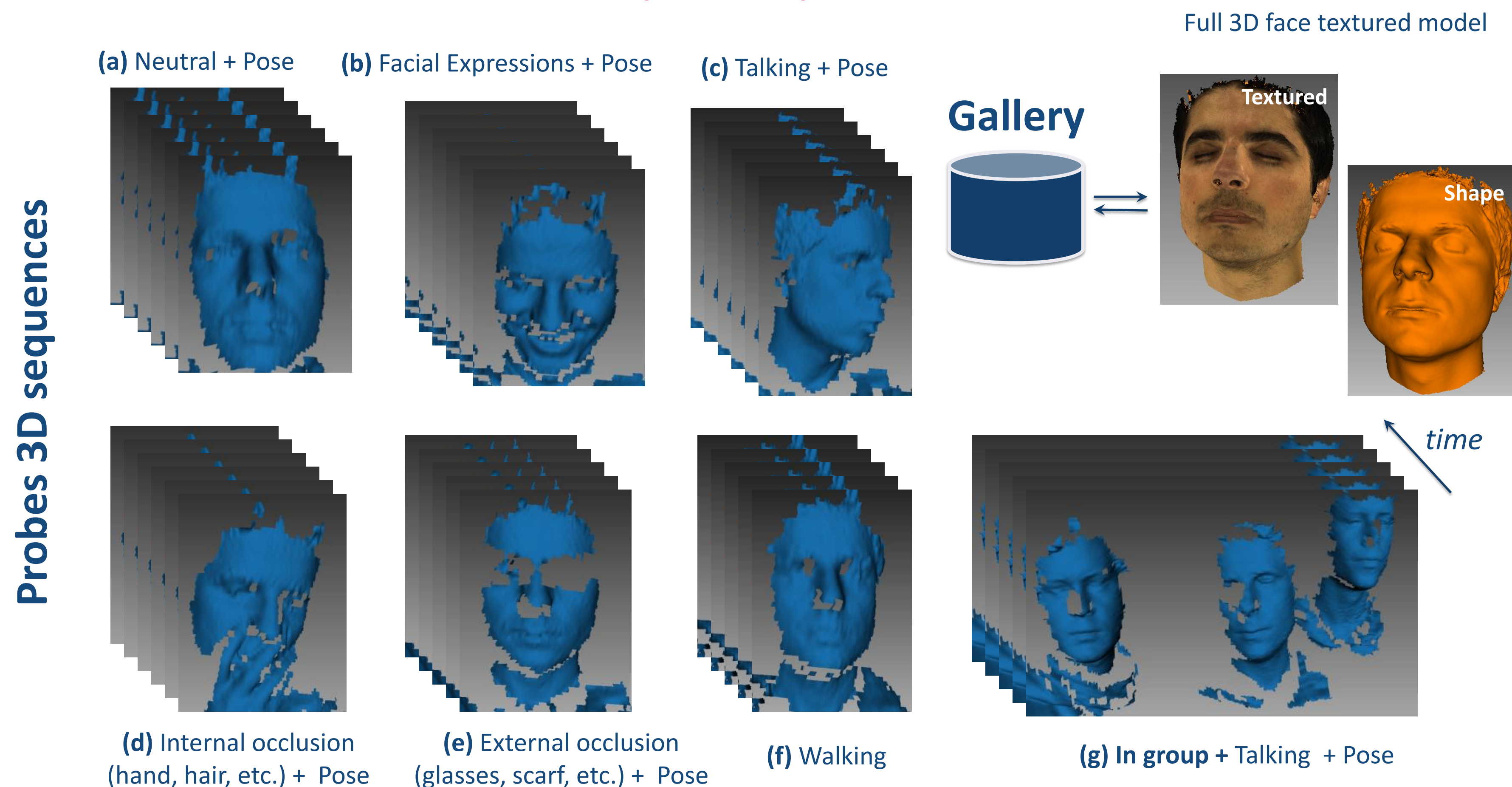T Media Integration and Communication Center, University of Florence, Italy

3D/4D Non-cooperative Database

Abstract

Automatic face recognition has been an important research topic over the past few years. Although a significant progress has been made, the task of automated, robust face recognition is still a distant goal. An emerging solution is to use laser scanners for capturing 3D observations of human faces, and use this data in performing face recognition. Such observations are relatively invariant to illumination and pose, although they do vary with facial expressions. However, the 3D models that have been used are all static. The most recent technological advances in 3D imaging allow for real-time 3D facial shape acquisition and analysis. Such 3D sequential data captures the dynamics of time-varying facial surfaces, thus allowing us to use 3D dynamic surface. In this thesis we address the facial geometry analysis for recognition and facial expression recognition from 3D sequences (3D plus time, or 4D). A more challenging problem in this thesis is to study the shape explicitly using the geometry of surface deformations evolving in time where the subjects that are acquired in the sequence can move during acquisition, changing their pose, facial expression or speaking thus opening and closing the mouth.

In this thesis, we will define new facial descriptors for 3D face frames of the sequence and for the temporal dynamics of the 3D video.

The TELECOM Lille1/LIFL 3D/4D FR Database

Probes 3D sequences

(a) Neutral + Pose (b) Facial Expressions + Pose (c) Talking + Pose
Full 3D face textured model — Gallery — Textured — Shape — time

(d) Internal occlusion (hand, hair, etc.) + Pose (e) External occlusion (glasses, scarf, etc.) + Pose (f) Walking (g) In group + Talking + Pose

Grassmannian Framework for 4D-to-4D FR

### Research Topic and Challenges

- Non-cooperative and unconstrained 3D Face Recognition in Dynamic sequences is a new trend in biometrics research field.

- The main challenges are:
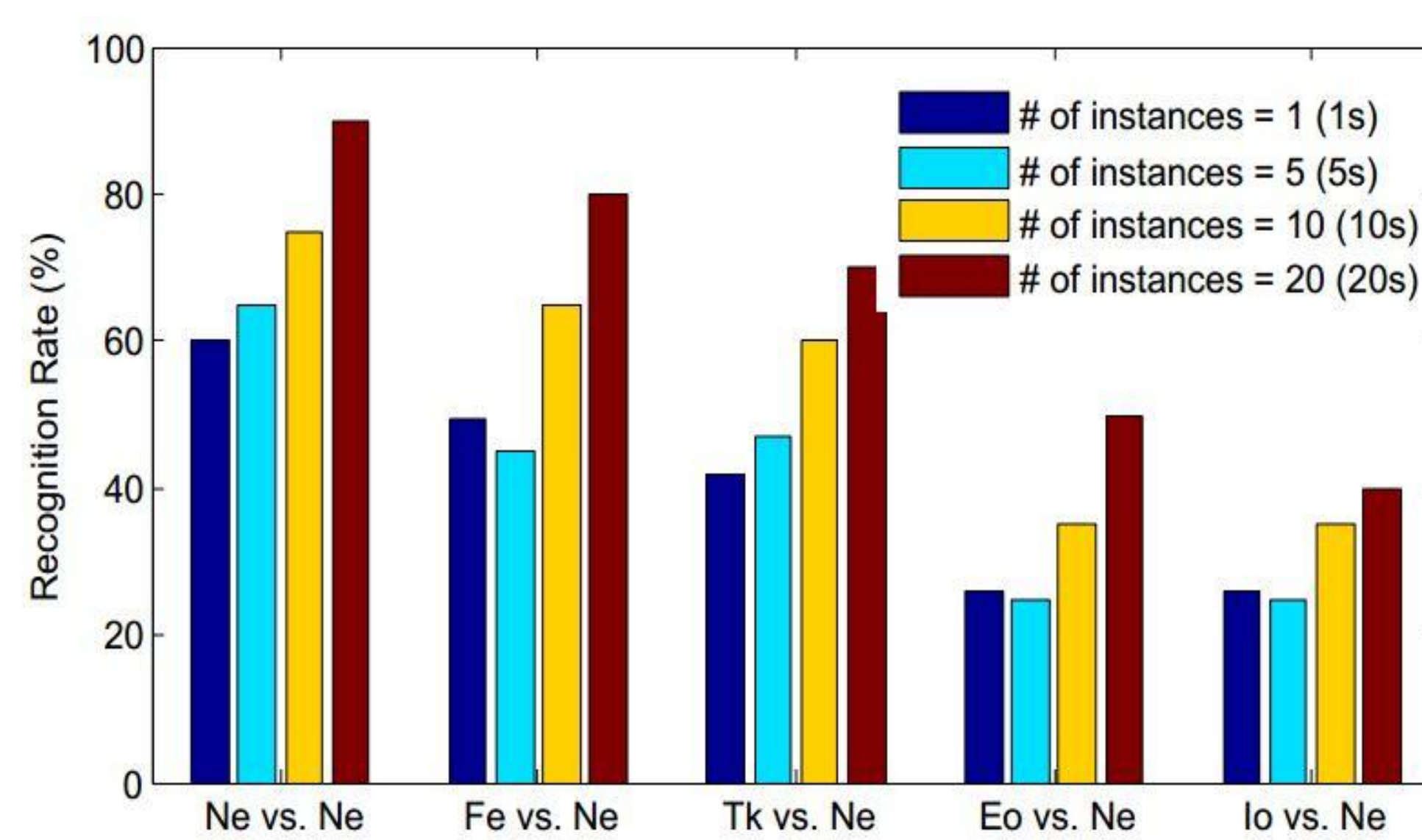 - Large pose variations
  - Expressions variations
  - Internal and external occlusions
  - Walking
  - Talking faces
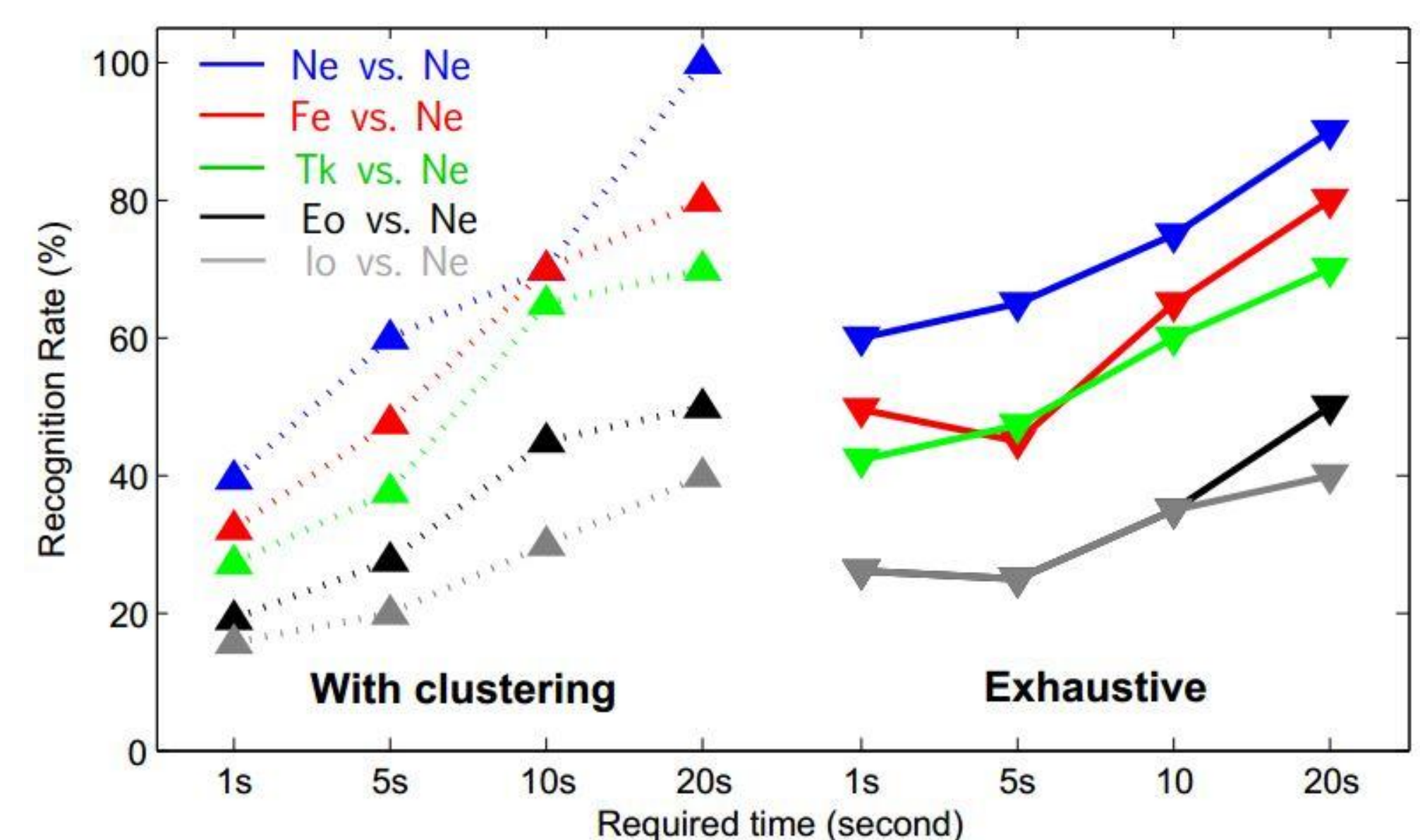 - Multi-persons recognition scenario

$$Y_1' Y_2 = U(\cos \Theta) V'$$
$$d_G^2(Y_1, Y_2) = \sum_i \theta_i^2$$
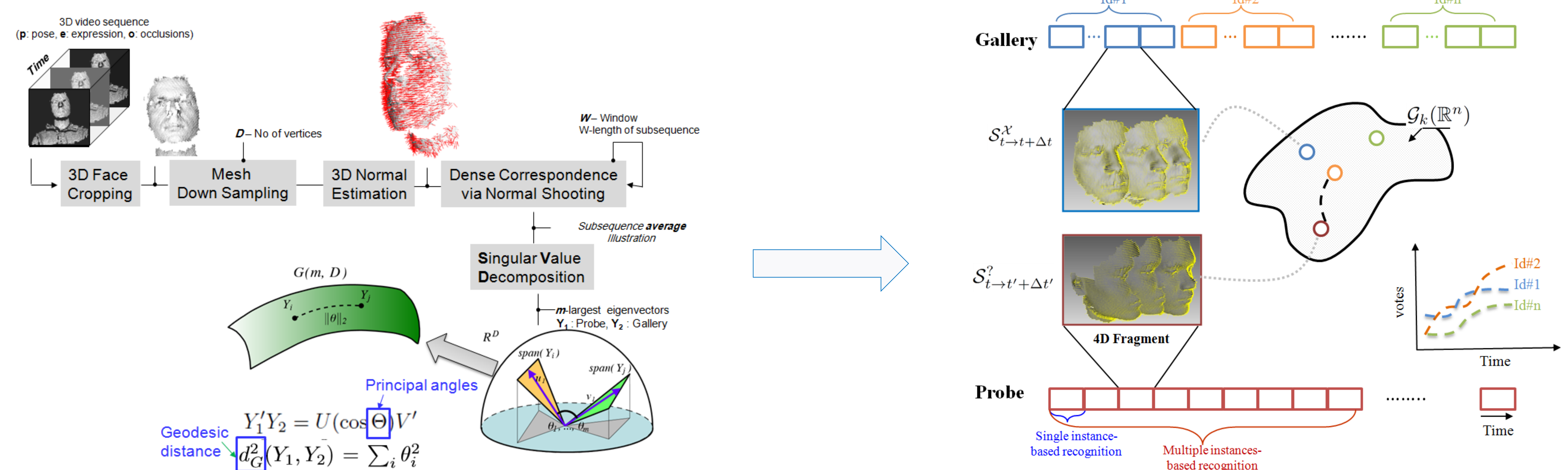
Experiments on 3D/4D Database
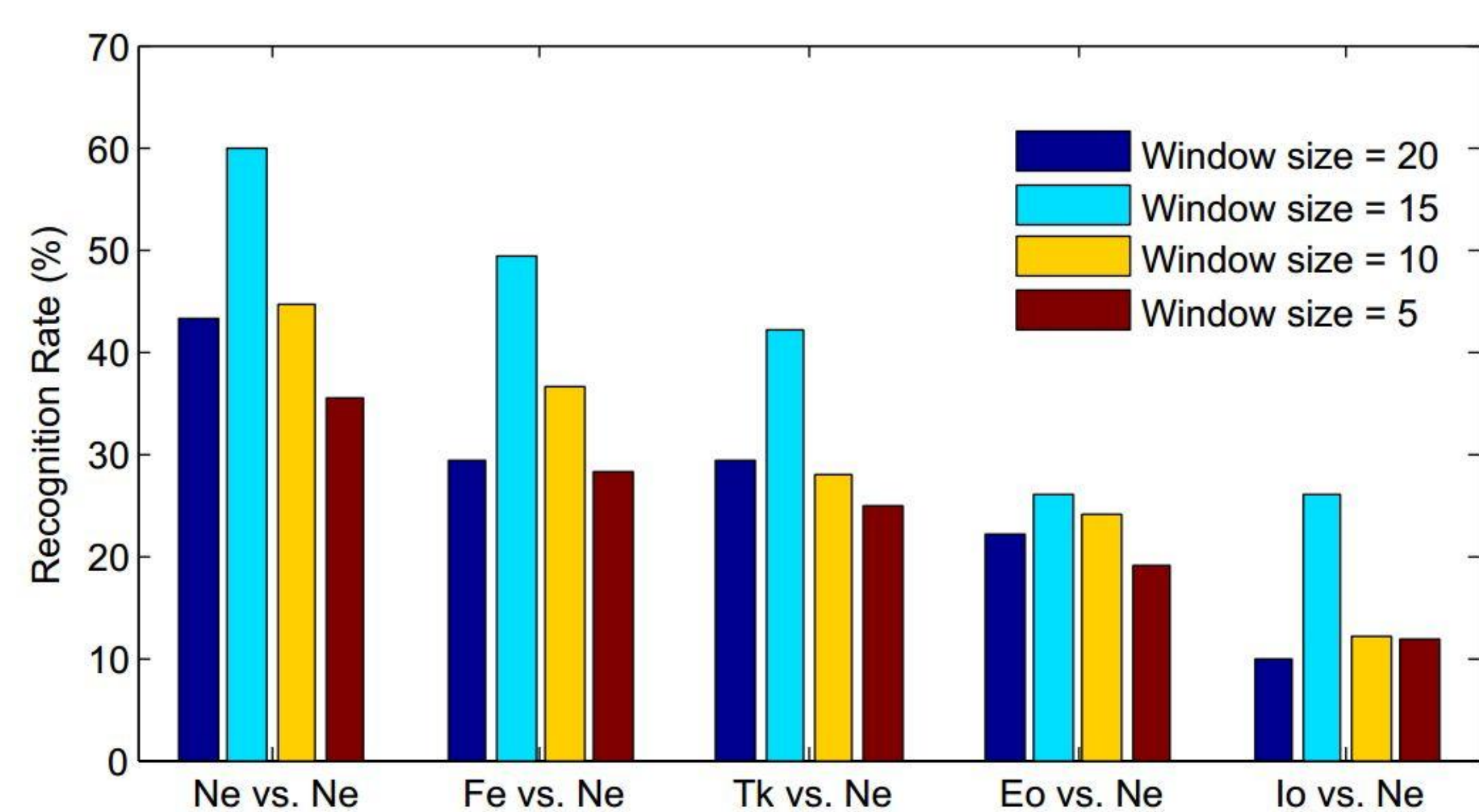
Exp.1: Single-instance based FR results as a function of the window size

Exp.2: Multiple-instances based recognition rates

Exp.3: Clustering-based vs. Exhaustive recognition results for each test scenario when varying the required time