

- [5] A popular way to standardize the different avatars is the Facial Coding Action System (FACS), which allows for fixed facial expressions and elementary movements of the face. With FACS, however, a potentially large management task is created in standardizing expressions and faces across all the avatars. The amount of variations in human faces leads to difficulties in differentiating anatomical features in underlying bone structure. With FACS, the goal is to only describe the physiological movement rather than the unique bone and tissue structure (i.e., the unique facial identity) of the person, in order to enable unique faces to all have the same expression. However, for each facial expression for a face, there are not just muscle contractions, but particular ways in which facial muscles slide over an underlying bone structure of the face. One major area in which inaccuracies form based on FACS standardization is in capturing the way wrinkles and skin folds appear on a face based on changing facial expressions. Therefore, digital artists are required to adapt these physiological movements to the unique ways the movements manifest based on bone structure, to include detailed wrinkles and skin folds for different faces across standardized facial expressions.
- [6] Thus, there is a need in the field of computer graphics to create a new and useful system and method for providing realistically deformed facial meshes with detailed wrinkles and skin folds. The source of the problem, as discovered by the inventors, is a lack of accurate automated methods to capture deformations in facial expressions in a detailed way.

SUMMARY ~~OF THE INVENTION~~

- [6a] In a first aspect, the present disclosure provides a method for providing face mesh deformation with detailed wrinkles, the method performed by a computer system, the method comprising: receiving a neutral mesh and a plurality of initial control point positions on the neutral mesh, wherein the neutral mesh is based on a three-dimensional scanned image of a face; receiving a plurality of user-defined control point positions corresponding to a non-neutral facial expression; generating a radial basis function (RBF) deformed mesh based on RBF interpolation of the initial control point positions and the user-defined control point positions; generating predicted wrinkle deformation data based on the RBF deformed mesh and the user-defined control points, wherein the predicted wrinkle deformation data is generated by one or more cascaded regressors networks; and providing, for display on a client device within a user

interface, a final deformed mesh comprising wrinkles based on the predicted wrinkle deformation data.

[6b] In a second aspect, the present disclosure provides a non-transitory computer-readable medium containing instructions for providing face mesh deformation with detailed wrinkles, the instructions for execution by a computer system, the non-transitory computer-readable medium comprising: instructions for receiving a neutral mesh and a plurality of initial control point positions on the neutral mesh, wherein the neutral mesh is based on a three-dimensional scanned image of a face; instructions for receiving a plurality of user-defined control point positions corresponding to a non-neutral facial expression; instructions for generating a radial basis function (RBF) deformed mesh based on RBF interpolation of the initial control point positions and the user-defined control point positions; instructions for generating predicted wrinkle deformation data based on the RBF deformed mesh and the user-defined control points, wherein the predicted wrinkle deformation data is generated by one or more cascaded regressors networks; and instructions for providing, for display on a client device within a user interface, a final deformed mesh comprising wrinkles based on the predicted wrinkle deformation data.

[7] One ~~embodiment~~ example relates to providing face mesh deformation with detailed wrinkles. The system receives a neutral mesh based on a scan of a face, and initial control point positions on the neutral mesh. The system also receives a number of user-defined control point positions corresponding to a non-neutral facial expression. The system first generates a radial basis function (RBF) deformed mesh based on RBF interpolation of the initial control point positions and the user-defined control point positions. The system then generates predicted wrinkle deformation data based on the RBF deformed mesh and the user-defined control points, with the predicted wrinkle deformation data being generated by one or more cascaded regressors networks. Finally, the system provides, for display on a client device within a user interface, a final deformed mesh with wrinkles based on the predicted wrinkle deformation data.

- [8] Another embodiment-example relates to computing diffusion flows representing the Gaussian kernel of the geodesic distance between the initial control point positions and all other vertices in the neutral mesh, and then determining the RBF interpolation of the initial control point positions and the user-defined control point positions based on the computed diffusion flows.
- [9] Another embodiment-example relates to segmenting each of a number of example RBF deformed meshes into a number of unique facial regions, and then training a cascaded regressors network on each unique facial region of the example RBF deformed meshes. These trained regressors networks are then used to generate the predicted wrinkle deformation data based on the RBF deformed mesh and the user-defined control points.
- [10] Another embodiment-example relates to predicting initial vertices displacement data using a displacement regressor as part of each of one or more cascaded regressors networks. The system then provides, for display on a client device within a user interface, a preview deformed mesh with wrinkles based on the predicted initial vertices displacement data. The system then predicts deformation gradient tensors using a deformation gradient regressor as part of each of the one or more cascaded regressors networks.
- [11] The features and components of these embodiments will be described in further detail in the description which follows. Additional features and advantages will also be set forth in the description which follows, and in part will be implicit from the description, or may be learned by the practice of the embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

- [12] FIG. 1A is a diagram illustrating an exemplary environment in which some embodiments may operate.
- [13] FIG. 1B is a diagram illustrating an exemplary computer system that may execute instructions to perform some of the methods herein.
- [14] FIG. 2A is a flow chart illustrating an exemplary method that may be performed in some embodiments.