4.3 PIE Database

The CMU PIE face database contains 41,368 face images of 68 individuals. Each individual was imaged under various poses, illuminations, and expressions. In this study, five near frontal poses (C05, C07, C09, C27, C29) and all the images under various illuminations, lighting, and expressions were gathered as 170 near frontal facial images for each individual as shown in Figure 5. The database is divided into training and testing sets for experiment. The applied divisions are \( n \) images per individual for training and 170-\( n \) images per individual for testing, where \( n = 5, 10, 20, \) and 30. Furthermore, the experimental results were averaged over 20 random sets for each division. Table 3 presents the least error rates and the corresponding dimensions. Both O-Laplacianfaces and NW-Fisherfaces outperformed the Fisherfaces and Eigenfaces. O-Laplacianfaces resulted in the least error rates on PIE database. However, the dimensionality required by the NW-Fisherfaces to reach its least error rate is much lower than the dimensionalities required by other methods. As shown in Figure 6, NW-Fisherfaces outperformed other methods over the dimensions below \( L - 1 \), where \( L \) is the number of individuals.

Fig. 5. Sample images of one individual with various expressions, illuminations, and lighting. There are total 170 images for one individual.