Facial palsy (FP) is a clinical condition resulting from damage to the facial nerve (FN) due to trauma, infections and vascular, congenital and neoplastic conditions. FP patients experience communicational, functional, and aesthetic difficulties (such as speech and articulation hardships, the inability to blink and protect the cornea and inability to smile). FP is currently treated mostly by static reconstructive procedures that typically only reposition features of facial structure to more appropriate location, and does not allow dynamic movement of facial muscles. Since most facial expressions are symmetric, and so are nearly all positive expressions, use of the contralateral healthy side of a FP patient to establish dynamic reconstruction of the paralyzed side is a natural choice. By recording healthy-side EMG as well as whisker and eyelid displacement and characterizing them, an understanding of EMG-facial muscle relationship can be established in rats. Next, using the relationship acquired from the healthy-side, functional electrical stimulation (FES) can be used to induce movement in injured side, such that similar displacements occur on both sides of the face, creating an almost symmetrical movement in spite of FP, thus allowing dynamic reconstruction of the paralyzed side.

The study, at first stage, focuses on animal models of FP, where the facial nerve in the animal is damaged. To establish EMG-facial movement relationship, whisker and eyelid movement, representing the most crucial facial movements (equivalent of lips and eyelid movements in humans), must first be detected.

My master’s project focuses on creating a system to acquire facial movements in the animal model, using videos acquired from a low-cost action-camera. Blinking behavior will be tracked based on pixel color information, after separating the eyes from the rest of the frame. I will use MATLAB Image Processing Toolbox to detect elliptical structures that qualify as eyes, and track them throughout the video. This will generate an output signal as the eye’s minor-axis length in each frame. Whisking behavior will be tracked using optical flow method, detecting motion between two following frames, thus creating an output signal representing the whiskers velocity. Acquiring the signals using the methods described above will enable modeling a system where the input is EMG and the outputs are whisking and blinking.