

Appendix 2: Discussion of the Issue of Correction of the Delay Introduced by the Savitzky-Golay used by Nystrom et al [1]

The Nystrom et al. [1] algorithm used the Savitzky-Golay filter code from Matlab (MathWorks, Natick, MA) to filter the raw position signal and to compute a first and second derivative of the filtered data. The steps used are as follows:

1. Determine the span of the filter. Minimum saccade duration = 0.010 seconds. Sampling frequency = 1000.

```
% Lowpass filter window length
smoothInt = minSaccadeDur; % in seconds
```

```
% Span of filter
span = ceil(smoothInt*SamplingFreq);
```

Therefore, span = 10 msec.

2. Determine filter window length:

```
F = 2*ceil(span)-1; % Window length
```

With span = 10, filter window length (F) = 19 msec.

3. Set filter order (polynomial order):

```
N = 2; % Order of polynomial fit
```

4. Calculate S-G coefficients:

```
[b,g] = sgolay(N,F); % Calculate S-G coefficients
```

5. X = raw horizontal position data, Y = raw vertical position data

6. Create smoothed version of X and Y, using the S-G coefficients:

```
Xsmooth = filter(g(:,1),1,X);
```

```
Ysmooth = filter(g(:,1),1,Y);
```

7. Calculate the velocity and acceleration using the S-G filter coefficients

```
velX = filter(g(:,2),1,X);
```

```
velY = filter(g(:,2),1,Y);
```

```
accX = filter(g(:,3),1,X);
```

```
accY = filter(g(:,3),1,Y);
```

Nystrom et al. [1] assert in their paper that: “Velocity and acceleration data were appropriately

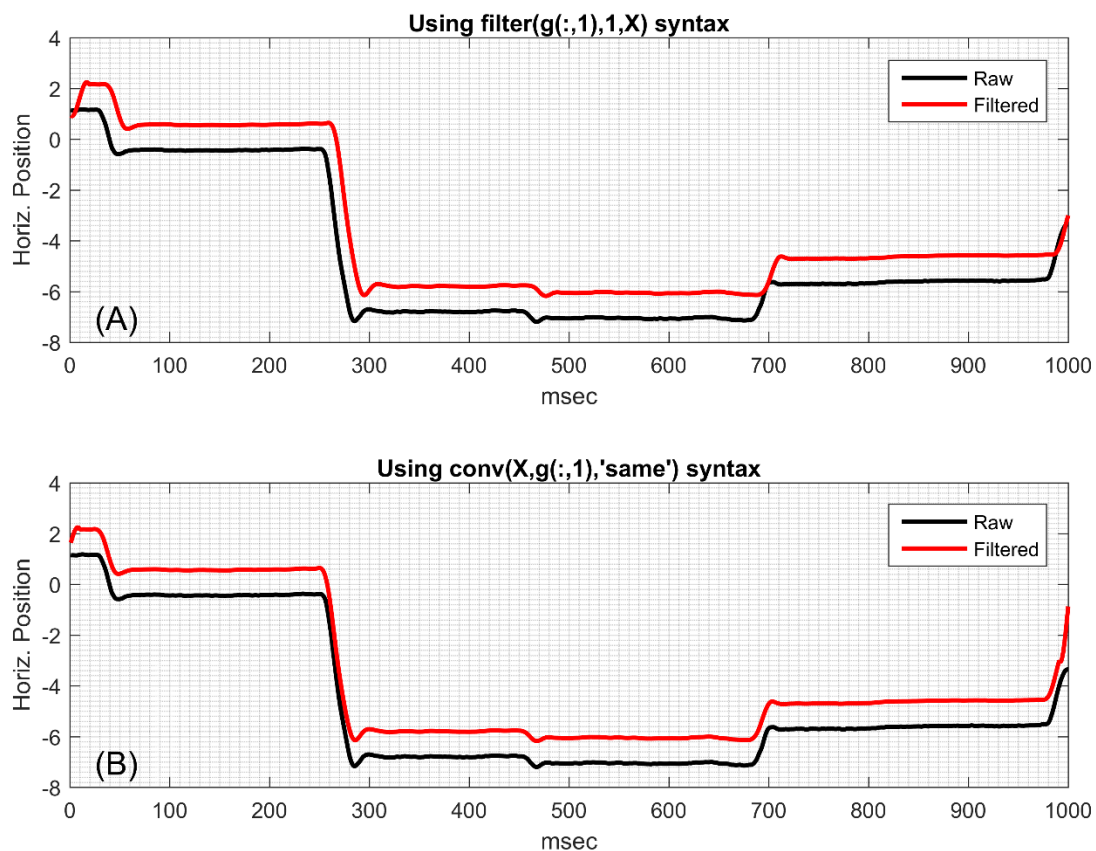
adjusted to compensate for the time shift introduced by the filters.” (page 192). We dispute this. Using the above code, the filter delay is not compensated for. For illustration, see Appendix Figure 1 (A). Note that using the syntax:

```
Xsmooth = conv(:,1),1,X);
```

rather than:

```
Xsmooth = filter(g(:,1),1,X);
```

would have corrected for the filter delay (Figure 1 (B)).



Appendix Figure 1. Illustration of filter delays. (a) Note the delay of the filtered data with respect to the raw data when using the method of [1]. (B) Note that when using the 'conv' syntax rather than the 'filter' syntax, the delay is removed.

- [1] M. Nystrom and K. Holmqvist, "An adaptive algorithm for fixation, saccade, and glissade detection in eyetracking data," *Behav Res Methods*, vol. 42, pp. 188-204, Feb 2010.