much horizontal translation bias, the horizontal translation weighting $Fi_{vwx}[n]$ need not be affected by hand scaling velocity $H_{vs}[n]$, as indicated by the lack of a hand scaling term in Equation 70. The translation weightings of the innermost and outermost fingers are unchanged by the polar component speeds, i.e., $FI_{vwx}[n] \approx FI_{vwx}[n] \approx FI_{vw}[n]$ad $FO_{vwx}[n] \approx FO_{vwx}[n] \approx FO_{wv}[n]$. Step **548** finally computes the hand translation velocity vector $(H_{vx}[n], H_{vy}[n])$ from the weighted average of the finger velocities:

$$H_{vx}[n] = \frac{\sum_{i-1}^{5} Fi_{vwx} Fi_{vx}}{\sum_{i-1}^{5} Fi_{vwx}} \tag{72}$$

$$H_{vi}[n] = \frac{\sum_{i-1}^{5} Fi_{vwy} Fi_{vy}}{\sum_{i-1}^{5} Fi_{vwy}} \tag{73}$$

[0258] The last part of the translation calculations is to test for the lateral deceleration of the fingers before liftoff, which reliably indicates whether the user wishes cursor motion to stop at liftoff. If deceleration is not detected prior to liftoff, the user may intend cursor motion to continue after liftoff, or the user may intend a special "one-shot" command to be invoked. Decision diamond **550** only invokes the deceleration tests while finger proximities are not dropping too quickly to prevent the perturbations in finger centroids which can accompany finger liftoff from interfering with the deceleration measurements. Step **551** computes the percentage acceleration or ratio of current translation speed $|(H_{vx}[n], H_{vy}[n])|$ to a past average translation speed preferably computed by a moving window average or autoregressive filter. Decision diamond **552** causes the translation deceleration flag to be set **556** if the acceleration ratio is less than a threshold. If this threshold is set greater than one, the user will have to be accelerating the fingers just prior to liftoff for cursor motion to continue. If the threshold is set just below one, cursor motion will reliably be continued as long as the user maintains a constant lateral speed prior to liftoff, but if the user begins to slow the cursor on approach to a target area of the display the deceleration flag will be set. Decision diamond **554** can also cause the deceleration flag to be set if the current translation direction is substantially different from an average of past directions. Such change in direction indicates the hand motion trajectory is curving, in which case cursor motion should not be continued after liftoff because accurately determining the direction to the user's intended target becomes very difficult. If neither deceleration nor curved trajectories are detected, step **558** clears the translation deceleration flag. This will enable cursor motion continuation should the fingers subsequently begin liftoff. Note that decision diamond **550** prevents the state of the translation deceleration flags from changing during liftoff so that the decision after liftoff to continue cursor motion depends on the state of the deceleration flag before liftoff began. The final step **560** updates the autoregressive or moving window average of the hand translation velocity vector, which can become the velocity of continued cursor motion after liftoff. Actual generation of the continued cursor motion signals occurs in the chord motion recognizer **18** as will be discussed with **FIG. 40**.

[0259] Note that this cursor motion continuation method has several advantages over motion continuation methods in related art. Since the decision to continue motion depends on a percentage acceleration which inherently normalizes to any speed range, the user can intentionally invoke motion continuation from a wide range of speeds including very low speeds. Thus the user can directly invoke slow motion continuation to auto scroll a document at readable speeds. This is not true of Watanabe's method in U.S. Pat. No. 4,734,685, which only continues motion when the user's motion exceeds a high speed threshold, nor of Logan et al.'s method in U.S. Pat. No. 5,327,161, which if enabled for low finger speeds will undesirably continue motion when a user decelerates on approach to a large target but fails to stop completely before lifting off. Percentage acceleration also captures user intent more clearly than position of a finger in a border area. Position of a finger in a border area as used in U.S. Pat. No. 5,543,591 to Gillespie et al. is ambiguous because the cursor can reach its desired target on the display just as the finger enters the border, yet the touchpad device will continue cursor motion past the target because it thinks the finger has run out of space to move. In the present invention, on the other hand, the acceleration ratio will remain near one if the fingers can slide off the edge of the sensing array without hitting a physical barrier, sensibly invoking motion continuation. But if the fingers decelerate before crossing or stop on the edge of the sensing array, the cursor will stop as desired.

[0260] The details of the differential hand pressure extraction process **508** are shown in **FIG. 38**. Fingertip proximity quickly saturates when pressure is applied through the bony tip normal to a hard surface. Unless the surface itself is highly compliant, the best dynamic range of fingertip pressure is obtained with the fingers outstretched and hand nearly flattened so that the compressible soft pulp underneath the fingertips rests on the surface. Decision diamond **562** therefore causes the tilt and roll hand pressure components to be set to zero in step **564** and pressure extraction to abort unless the hand is nearly flattened. Inherent in the test for hand flattening **562** is a finger count to ensure that most of the five fingers and both palm heels are touching the surface to maximize the precision of the hand pressure measurements, though technically only three non-collinear hand contacts arranged like a tripod are necessary to establish tilt and roll pressures. Decision diamond **562** can also require the user to explicitly enable three-dimensional manipulation with an intuitive gesture such as placing all five fingers on the surface, briefly tapping the palm heels on the surface, and finally resting the palm heels on the surface. Decision diamond **566** causes step **568** to capture and store reference proximities for each contact path when the proximity of all contacts have stabilized at the end of this initiation sequence. The tilt and roll pressure components are again zeroed **564** for the sensor array scan cycle during which this calibration is performed.

[0261] However, during subsequent scan cycles the user can tilt the hand forward applying more pressure to the fingertips or backward applying more pressure to the palm heels, or the user can roll the hand outward onto the pinky and outer palm heel or inward applying more pressure to the thumb, index finger and inner palm heel. Step **570** will proceed to calculate an unweighted average of the current contact positions. Step **572** computes for each hand part still touching the surface the ratio of current proximity to the reference proximity previously stored. To make these ratios less sensitive to accidental lifting of hand parts, step **574** clips them to be greater or equal to one so only increases in