Examples of Potential Track Hypotheses

Consider a step being broken down into three phases: entry, mid-stance, and withdrawal.

Hypothesis 1) Foot movement is correlated among phases.
Rationale: When walking, a bird or bipedal dinosaur often has both feet on the ground at once. Therefore, the path of one foot should be affected by the path of the other.

Hypothesis 1a) Foot entry angle is steepest (more vertical) in short steps, but becomes shallower (more forward and down) in longer steps.
Rationale: In short steps, body weight is transferred quickly from trailing foot to lead foot. In longer steps, push-off from the trailing foot makes the lead foot slide forward while sinking prior to complete weight transfer.

Hypothesis 1b) Foot entry deepens as foot withdrawal forces increase.
Rationale: In sloppier substrates, the lead foot will continue to sink in mid-stance because the trailing foot experiences a pull as it tries to withdraw.

Consider a single toe moving through a layered substrate with many surfaces.

Hypothesis 2) Sealed slits record hidden information.
Rationale: Although the path of the toes and foot completely collapse, evidence of toe diameter and orientation is preserved if we know how to look for it.

Hypothesis 2a) Toe diameter can be reconstructed from slit morphology.
Rationale: Thick toes displace more material than thin toes, and so should leave behind diagnostic features of their passage.

Hypothesis 2b) Evidence of digital pads is preserved in slit morphology.
Rationale: Toes are not simple cylinders, but instead have enlarged pads around each joint. If Hypothesis 2a is correct, such variation in diameter along a toe should be detectable from slit morphology.

Hypothesis 2c) Toe orientation and direction are preserved in slit morphology.
Rationale: A horizontal toe descending vertically should deform layers differently than a vertical toe moving horizontally. Likewise, a toe rotating or moving diagonally should be discernible.

Hypothesis 2d) One-way and two-way movements can be distinguished from slit morphology.
Rationale: A descending toe should create a simple deformation that is disrupted if the toe returns along a similar path.

Consider just particles in a volume rather than surfaces.

Hypothesis 3). Track formation can be understood by focusing on a tiny subset of particles.

Hypothesis 3a) Foot entry is best characterized by the most deeply displaced particles.
Rationale: Particles dragged down farthest are most informative. The collapsed walls of entry slits add no significant information about foot trajectory.

Hypothesis 3b) Foot withdrawal is best characterized by the most elevated particles.
Rationale: Particles lifted highest are most informative. Particles undergoing small increases in height provide no new information.