Panel Discussion: Robotics and other challenges for computer supported geometrical reasoning

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Challenges

• "Citius, Altius, Fortius!" (eg. P. Quaresma competition!)

• Linkage automated analysis and design

• Cooperation with education stakeholders: Is there Euclidean geometry in education? Competencies, PBL, IBL, STEAM...

• AR: visually impaired people, math trails, art analysis
Interesting open Problems

- Can dynamics be formulated within the algebraic framework?
- Complete solution of planar and spatial wire robots?
- Multiplicity of solutions.
- Global path planning of mobile robots.
- Overconstrained 6-R classification - underconstrained extreme n-R linkages.
Linkages:

Automatic derivation of locus equation
Verification of correctness of the expected performance
Automatic redesign for achieving a desired movement
Cooperation with education stakeholders

The key is to make a start, beginning with exploratory studies of the potential of these new tools at both the secondary and post-secondary levels.

https://en.wikipedia.org/wiki/Gila_Hanna
• **GeoGebra’s automated proving tools**

GeoGebra ...has gained in popularity over the last twenty years and is now widely used... GeoGebra has recently added an Automated Reasoning Tool (ART) to help students conjecture that a given property holds for a specific geometric object and then to find a proof that their conjecture is true. If that is not the case and the property does not hold, ART can also help students make the necessary changes to the original conjecture (Hohenwarter, Kovács, & Recio, 2019, p. 216).
Since the developers of GeoGebra added reasoning tools to their software, they have published a large number of papers in scholarly journals describing the potential of those tools for secondary-school learning...These additions appear to benefit students at both the undergraduate and the secondary level.

It is perhaps too early for empirical studies of classroom experience using the enhancements to GeoGebra... While it is reasonable to expect proof technology to foster students’ proving abilities, and there is certainly supporting anecdotal evidence, its potential advantages have not yet been systematically assessed.
Proof assistants that meet the requirements of these stakeholders

(the curriculum decision makers (who specify the standard of mathematical validation at a given grade), the teachers (who orchestrate learning and decide what counts as a proof in relation to a standard), and the learners (who are simultaneously constructing an understanding of proof and of the related content) Balacheff & Boy de la Tour

will never be developed in the absence of initiative on the part of mathematics educators and a demonstrated demand fuelled by increased use. Secondly, success also requires new and effective teaching strategies. These two efforts stand in a reciprocal relationship, so that the full benefit of proof assistants will be seen only over time as new teaching strategies effect the demand for new tool features and vice versa. The responsibility for both efforts rests squarely on the shoulders of educators


AR: visually impaired people, math trails, art analysis
A = (-2.08, -1.33)
B = (3.72, -1.33)
C = (-1.66, 3.81)
F = (-1.67, -1.19)
poly1 = 25.01
f = 5
c: x^2 + y^2 - 1.67x - 2.61y = 1
j = 7.07
k = 7.07
l: 0.02x + 5y = 19.05
m: -0.02x - 5y = 5.96
n: 5x - 0.02y = -8.35
p: -5x + 0.02y = -16.66

Discovered theorems on point C

Concyclic points: CDEF
Sets of parallel lines:
- CE \parallel DF
- CF \parallel DE
Congruent segments:
- CD = EF
- CE = CF = DE = DF

OK
It is generally true that:

- \( c = (\sqrt{-2+2}) \cdot e \) or \( c = (\sqrt{2+2}) \cdot e \)

under the condition:

- the construction is not degenerate

It is generally true that:

- \( d = (\sqrt{2}) \cdot e \)

under the condition:

- the construction is not degenerate

THANKS

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